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A MAGAZINE OF METHODS FOR OPERATING MEN

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MEETINGS

American Chemical Society, Division Organic Chemistry—December 28, 29, and 30, Richmond, Virginia.

•

California Natural Gasoline Association—January 6, Richfield Building, Los Angeles, California.

•

American Institute of Mining and Metallurgical Engineers, Annual Meeting — February 14, 15, 16, and 17, Engineering Societies Bldg., New York City.

•

American Petroleum Institute, Division of Production, Mid-Continent District, Spring Meeting—February 17 and 18, Herring Hotel, Amarillo, Texas.

•

American Society for Testing Materials, Spring Regional Meeting and Group Committee Meetings—March 7, 8, 9, 10, 11, and 12, Seneca Hotel, Rochester, New York.

•

American Association of Petroleum Geologists, 23rd Annual Meeting—March 16, 17, and 18, Roosevelt Hotel, New Orleans, Louisiana.

•

American Society of Mechanical Engineers—March 23, 24, and 25, Los Angeles, California.

•

American Petroleum Institute, Division of Production, Southwestern District, Spring Meeting—March 24 and 25, Blackstone Hotel, Fort Worth, Texas.

•

Petroleum Industry Electrical Association—April 13, 14, and 15, Rice Hotel, Houston, Texas.

•

American Chemical Society—April 17, 18, 19, 20, and 21, Dallas, Texas.

•

American Petroleum Institute, Division of Production, Eastern District—April 28 and 29, William Penn Hotel, Pittsburgh, Pennsylvania.

•

International Petroleum Exposition—May 14, 15, 16, 17, 18, 19, 20, and 21, Tulsa, Oklahoma.

•

American Petroleum Institute, Eighth Mid-Year Meeting — May 23, 24, and 25, Wichita, Kansas.

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The Course of Oil

By K. C. SCLATER

The Shut-Down Fallacy

Action on the reduction of allowables in the East Texas field has been delayed thirty days. Confronted with what it admits is a grave situation, the Railroad Commission of Texas, following its December hearing at Austin, has postponed making a decision in order that it may have more time to deliberate on the many conflicting angles involved in a further reduction in allowable.

The desire of the Commission to proceed cautiously is commendable; but is not undue caution being exercised? It would certainly seem so in view of the vast amount of engineering data already available on underground conditions in the East Texas field, particularly with respect to the trend of bottom-hole pressures in relation to the rate of withdrawal. Those familiar with underground conditions in the East Texas field and who are sincerely interested in seeing that the field is produced efficiently realize the urgent need for reducing the rate of withdrawal from the pool. Quick action, however, is hampered. The Railroad Commission seems to be in a dilemma—and for a good reason.

Factors that involve reservoir energy in a pool may transcend in importance all other factors when considering the economic life of that pool. This is particularly true in the East Texas field. Despite this fact, and the mass of data available on the East Texas field that prove it to be a fact, there is hesitancy about making a further reduction in the daily allowable production. The real reason behind this hesitancy and the further deliberation of the problem by the Railroad Commission is the marginal well law. This law is the obstacle that accounts for resorting to shutting down the field on four consecutive Sundays, apparently to gather more precise data on the rapid decline in recent months of bottom-hole pressures in the field.

So far as the volume of oil and also the energy withdrawn from the pool are concerned, these shut-downs accomplished what might have been done by reducing the allowable daily production in the ordinary manner. To attempt to deny this must be construed as an effort, and a feeble one, to disprove what the actual data concerning underground conditions in the field show. These data the engineers of the Commission have compiled from actual records gathered in the field over a period of several years. Curves of the average bottom-hole pressure and volume of oil produced indicate that the present rate of withdrawal from the field is too high for continued efficient production.

Getting down to concrete figures: A study of compiled engineering data on the East Texas field indicate that the daily withdrawal should not exceed 375,000 to 400,000 barrels—and this includes water—to maintain a reasonably slow decline of bottom-hole pressure whereby water encroachment would be retarded sufficiently that advantage would be taken of the natural water drive in producing the oil, and so conserve energy and minimize underground waste. Instead of adhering strictly to this rate of production a minimum of 400,000 barrels daily seems to have been adopted only as a compromise. Many of the operators in the field in the early days in favor of a high allowable were not so well versed in or familiar with the importance of conserving energy and so were skeptical of the advantages to be gained by curtailment.

In addition to the present high daily rate of production, water is also being produced with the oil in increasing quantities. It is estimated that at present the probable volume of water produced with the oil is not less than 75,000 barrels daily. Every barrel of water brought to the surface represents an expenditure of energy. Much of this energy might be conserved for the production of oil. The rapid decline in bottom-hole pressure is further accelerated by an increase in the quantity of water produced. Quite aside from these evils is the fact that all salt water produced with the oil must be disposed of in such a manner as to prevent pollution. In view of these detrimental effects the increasing production of water is a very real threat to the field. A substantial reduction in water production can be made only by retarding the decline in bottom-hole pressure. There is abundant evidence to show that a reduction in the daily allowable production would benefit the majority of operators in the pool and injure none.

A reduction that would effect such a result would mean cutting the allowable production of almost all the wells in the field below that allowed wells under the marginal well law. Almost 75 percent of the wells in the East Texas field are already marginal wells, there being now some 24,150 wells completed. Of these more than 18,000 are in the marginal well class, producing twenty barrels or less a day. The average daily production of each of the remaining wells (almost 5900) is approximately twenty-two barrels.

A reduction in well allowables to below that of the marginal allowance would, it is feared, draw protests and the possibility of court injunctions on the part of a few operators. It is this fear that lies at the bottom of the delayed action. It is also this fear that has led to the four Sunday shut-downs and partly to the subsequent proposal of a Sunday shut-down for all fields in the state.

In the face of the overwhelming evidence of the serious harm that is resulting to the East Texas field by continuing to produce at too high a daily rate, it seems incredible that the opposition of a small minority group of operators should be allowed to stand in the way of relieving an onerous condition that jeopardizes the interests of not only the operators in the East Texas field but of every producer in the State of Texas.

It is reiterated here that a reduction in daily allowable in the East Texas field will accomplish the same results—and probably more efficiently—in energy conservation and prevention of waste that shut-downs will; but will it overcome the dissenting opinion of the few who would invoke the marginal well law?

« « HIGHLIGHTS IN OILDOM » »

Would Test Validity of Texas Gas Law

Machinery has been put in motion for testing the validity of Texas' gas waste law. The first step was the granting of an order by District Judge Ralph Yarborough restraining the Consolidated Gas Company, one of the largest companies operating in the East Panhandle area, from violating the new order of the Railroad Commission fixing gas-producing allowables in the East Panhandle sweet gas area. Judge Yarborough's order also attempts to stay federal court proceedings that Consolidated already has instituted. It also stays enforcement of the commission's allowable order.

The Consolidated Gas Company was the one that brought the suit attacking, in federal court, the first gas order under Senate Bill 266, the gas waste law. The suit was carried to the Supreme Court of the United States, which body held that the commission could not compel Consolidated to purchase gas from its neighbors if its own wells could produce without waste the gas needed by the company. The Supreme Court ruling, however, applied directly only to the commission's orders, not to the validity of the law. The law itself never has been tested in the courts.

Soon after the commission issued its November order, again attempting gas proration in the Panhandle, the Consolidated Gas Company filed suit in federal court to enjoin its enforcement. Following several postponements the hearing was set for December 20 before a three-judge federal court. Desiring, however, to have the law tested in state courts rather than federal, state's attorneys countered with the proceedings in Judge Yarborough's court. The case has been set for hearing January 24.

●

Marland Invites Governors to Attend Parley

Governor E. W. Marland of Oklahoma has invited the governors of all oil-producing states to participate in a conference to discuss "ways and means to prevent overproduction of oil, and ways and means of stabilizing the price of oil to prevent abandonment of wells and waste of our oil resources." The conference will be held January 24 at Hot Springs, Arkansas.

●

State Helium Monopoly in Peru

The Government of Peru has declared that helium existing or which may exist in the country is a state monopoly. The Mines and Petroleum Department will investigate oilfield gases, and oil companies are required to submit half-yearly reports on the analyses of gases found.

●

Oppose Move to Eliminate Depletion Allowance

Attempts by representatives of the United States Treasury Department to have eliminated from the revenue law depletion allowance for oil and gas is meeting with strong opposition from members of the petroleum industry. It is stated that such action would affect seriously any planning for future investments in exploratory or wildcat work.

In a recent letter to President Roosevelt, Secretary Morgenthau of the Treasury Department said he recommended in 1933 that the depletion provision be repealed, but Congress had done nothing about it. He again is recommending that action be taken.

To Stimulate Exploration in Roumania

The Roumanian government, concerned about the decline in production of petroleum, has drawn up a decree-law designed to stimulate exploration. The new measure guarantees to explorers a minimum area of 2500 hectares in districts where petroleum is known to exist. This more liberal attitude on the part of the government already has resulted in numerous applications for exploration areas.

●

Quota Problem Flares Again at Rodessa

When pipe line companies declined to take oil in excess of allowables from wells on the Louisiana side of the Rodessa field and voluntarily cut runs from Miller County, Arkansas, wells to 200 bbl. each, it was thought that the production situation along the border of the two states had been settled. Now, however, the controversy has flared up anew.

One pipe line company was reported to be taking runs from two Louisiana wells whose production totals 1570 bbl., as compared to 1056 bbl. earlier. The federal tender board at Kilgore is said to be planning to take up the matter with Washington headquarters, as the oil was to be routed into Texas, thereby giving the matter an interstate angle.

Declines in production and the policy of pipe line companies in limiting purchases in Miller County apparently will take care of the excess production there. The Arkansas Board of Conservation recently deferred until January 1 an allocation of production originally scheduled to go into effect November 16.

●

Large Power Plant for Venezuela

The J. G. White Engineering Corporation of New York City has been awarded a contract for the design and construction of a 20,000-kw. power plant for The Venezuelan Oil Concessions, Ltd., a subsidiary company of the Royal Dutch-Shell group, operating in Venezuela. The Venezuelan Oil Concessions, Ltd., now operates an extensive field on the eastern shores of Lake Maracaibo, approximately 60 miles south of the city of Maracaibo, Venezuela.

The boilers of the new plant are designed to be operated either with natural gas or oil from the adjacent oil fields, and as this fuel is of low cost, the station is designed primarily for simplicity and reliability and of moderate first cost.

A 1500-ft. channel is being dredged to deep water in the lake for a suitable supply of condensing water. The waters of Lake Maracaibo are brackish and a special evaporating plant has been designed to provide make-up water for the boilers.

The distribution of power from the plant to the oil wells will be by means of a 33,000-volt double-circuit steel-tower transmission line 35 miles long.

The oil wells are situated along the length of the line and the high tension power from the transmission line will be reduced in eight sub-stations for local distribution and to service transformers for small adjacent groups of wells.

The four 5000-kw. turbo-generators and the four 1000-hp. boilers, as well as practically all machinery and materials, are being manufactured in the United States.

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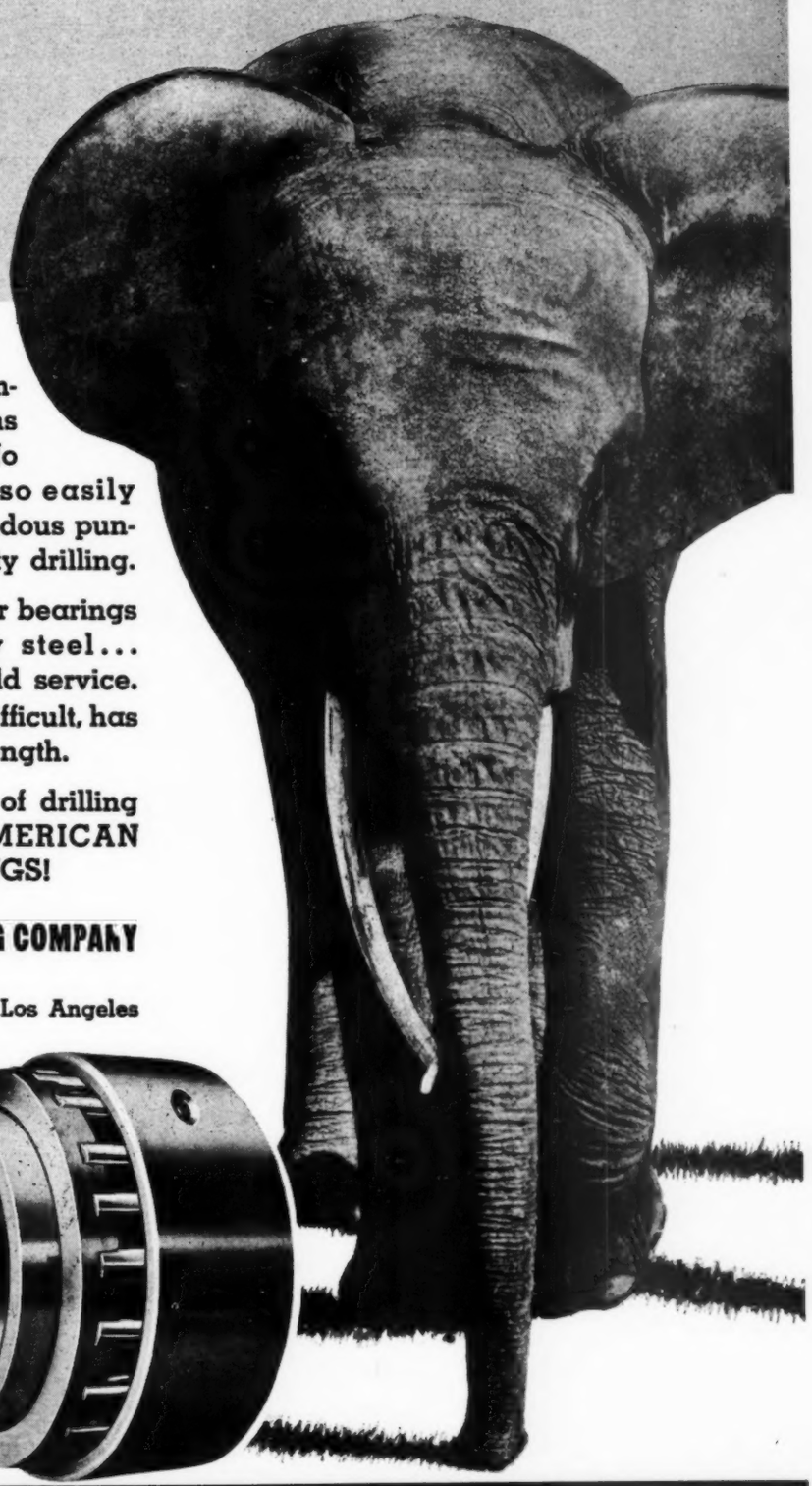

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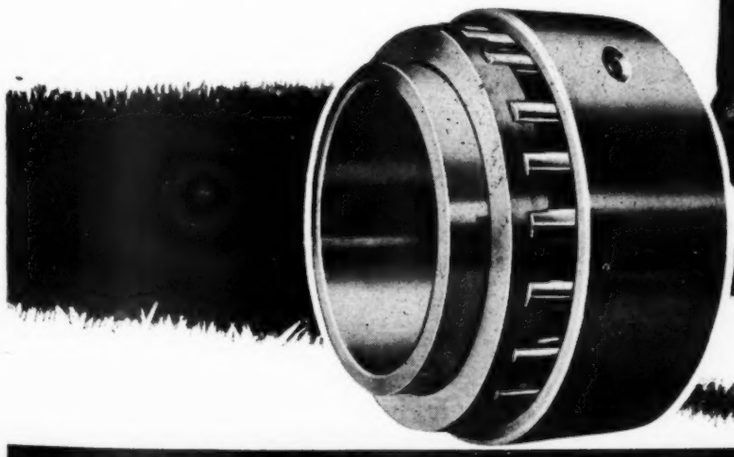

AMERICAN *HEAVY DUTY* *ROLLER BEARINGS*

Ecuador Grants New Oil Concession

The Ecuadorian Government has granted to the International Petroleum Company of Toronto, Canada, an oil exploration concession of approximately 500,000 acres along the seacoast. The International Petroleum Company owns a substantial interest in the National Carare Company, Colombia, and will explore 38,000 acres owned by that company in the State of South Santander.

Second Iraq Pipe Line a Possibility

Terms of a concession granted British Oil Development Company, Ltd., by the Iraq government stipulate that a means of transporting oil to the Mediterranean must be provided by October, 1939, in event marketable oil is found in sufficient quantities to justify. Either a pipe line or railway would be constructed, and indications are that it would be the former.

Although large productive areas have been proved, the crude is not marketable as it contains seven percent sulphur. The technical staff of each of the various interests associated with Mosul Oilfields, Ltd., the holding company, is making studies in an effort to determine a means of treating the oil so that transportation by pipe line to deep water will be practicable.

Government Wins Elk Hills Suit

The federal court at Los Angeles has decided for the government in its suit against the Standard Oil Company of California for title to the Elk Hills oil land held by the latter. Federal Judge Leon Yankwich has held that the state, in obtaining the land from the federal government for school purposes, had no right to turn it over to private interests.

Damages of $6,164,102 were assessed. Of this amount $1,896,819.67 was assessed jointly against the Standard Oil Company and two individuals, Clara Fairbanks and Frank J. Raneny of El Paso. Interest on the claim, which would have doubled the damages, was denied the government.

Recommends Exploration in Bolivia

Recommendations have been made by the Brazilian-Bolivian mixed commission to their respective governments to undertake the study and exploration of petroleum deposits in the sub-Andean zone from the Parapeti River northward to the Bolivian border.

The recommendations are that the two countries appoint and jointly pay the expenses of a mixed technical commission to undertake the studies, the conclusion indicating that $1,500,000 should be appropriated for the studies and explorations, likely to extend over a three-year period.

Should the studies and explorations lead to commercial exploitation, the Government of Bolivia, in recompense for Brazilian aid in the preliminary phase, is obligated to organize mixed Brazilian-Bolivian companies to exploit the petroliferous areas, to refine the petroleum produced, and, after satisfying Bolivian requirements, to supply the Brazilian market. Petroleum not marketed in Brazil or Bolivia then may be exported in free transit through Brazil, preference being given under equal economic conditions to the Santa Cruz-Corumba route.

In addition, the recommendations provide that Bolivia shall consent to the construction of a pipe line from the petroleum fields to the Brazilian frontier or a port on the Paraquay River.

Open University Lands for Geophysical Work

University of Texas lands, scattered over nine West Texas counties, have been opened for geophysical exploration until February 15, it has been announced by the leasing board of the university. This action was taken to enable prospective bidders at the public auction sale to be held at Austin next February to acquire more information concerning the lands. In all there will be 53 blocks.

Those tracts now open for exploration are:

Andrews County: Blocks 1, 2, 9, 10, 11, 12, and 13.

Crane and Ector counties: Blocks 30, 31, and 35.

Reagan, Upton, and Crockett counties: Blocks 1 to 13, inclusive; 29 to 33, inclusive; 49, 50, 51, and 58.

Terrell County: Blocks 34, 35, 36, and 37.

Open for geophysical exploration also is that portion of the Huntington lands south of Jones Bay, Galveston County.

Another Reduction in Pennsylvania Grade Prices

Pennsylvania grade crude suffered another reduction in price on December 1, the third in recent months. The reductions, ranging from 15 to 18 cents, were announced by the Joseph Seep Purchasing Agency of the South Penn Oil Company and other purchasers stated they would reduce their prices accordingly. This latest price cut was the result of a decrease in refinery demand, it was stated.

The new prices are as follows: Bradford and Alleghany districts, $2.20 a bbl., a decline of 15 cents; Eureka pipe lines, $1.82, a decline of 18 cents; Southwest Pennsylvania pipe lines, $1.88, a decline of 17 cents; and Buckeye pipe lines, $1.70, a decline of 15 cents. The price of Corning grade crude is unchanged at $1.27.

Petroleum Electric Power Club Meets

Means of effecting even closer relationship between the electric power and petroleum industries, the present and future status of electric power in relation to the production, transportation, and refining of crude oil were among the matters claiming attention of those in attendance at the annual meeting of the Petroleum Electric Power Club at Shreveport, Louisiana, December 10.

At the closing session reports of the standing committees were heard and officers elected for the ensuing year.

The new officers are: C. N. Robinson, Oklahoma Public Service Company, Tulsa, president; O. W. Jones, Central Power and Light Company, Corpus Christi, Texas, vice-president; H. E. Roberts, Empire District Electric Company, Joplin, Missouri, secretary-treasurer.

Directors for the 1938-39 term are: W. H. Stueve, Oklahoma Gas and Electric Company, Oklahoma City; H. E. Roberts; George H. Weckel, Kansas Gas and Electric Company, Wichita; F. A. Graham, Kansas City Power and Light Company, Kansas City; J. E. Elliott, Southwestern Gas and Electric Company, Shreveport, Louisiana; E. A. Armstrong, Public Service Company of Northern Illinois, Chicago.

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Latest Activities In The Oil Fields

Another South Texas field was opened by No. 7 Seeligson of the Magnolia Petroleum Company five miles east of the Premont field in Jim Wells County. The well flowed approximately 200 bbl. of 36.5-gravity oil in 13 hours through perforations and is producing from a depth of 6585 to 6595 ft., after plugging back from 8165 feet.

●

C. C. Dorr et al's No. 1 Payton, wildcat test in northern Pecos County, Texas, N½ N½ 99-8-H & GN, flowed by heads through tubing at the rate of 40 bbl. daily. The total depth is 2037 ft. in sand found at 2005 feet.

●

One mile west of the Letsch area in Russell County, Kansas, Shields et al's No. 1 Giese, SE NE 28-14-13, has opened what appears to be a prolific new area. After a 5000-gal. acid treatment the well pumped at the rate of 2145 bbl. daily. The total depth is 2915 feet.

●

Several months ago H. F. Wilcox Oil and Gas Company completed No. 1 T. J. Gilliam in the Batesville district, northwestern Zavala County, Texas. It flowed at the rate of 5000 bbl. daily of low-gravity oil from a depth of 3496 feet. The producing formation was thought to be the Edwards lime, but is now recognized as Georgetown lime. The well soon went to water; however, early in December the same company completed No. 2 Gilliam, a southwest offset, at a depth of 3977 ft. in porous saturated Edwards lime. The first well will be deepened immediately to the same formation. The district is far removed from any other production.

●

One and a half miles southeast of the Denver pool, Yoakum County, Texas, Toddie L. Wynne's (American Liberty) No. 1 Thomas flowed 281 bbl. in 36 hours when tested after treatment with 1000 gal. of acid. The total depth of the well is 5030 feet. Southeast of this well, the same operators' No. 1 Willard had a showing of gas at a depth of 4700 ft. and is drilling ahead.

Ohio Oil Company's No. E-3 Kern County Land Company in section 14, 30-25, two and a half miles northwest of Ten Section field, California, was completed November 20, and tested. It flowed 2267 bbl. daily of 37-gravity oil through a 1-in. bean. The total depth of the well is 8175 feet. The area proved by the new well is classed as a new field, rather than an extension of Ten Section, and has been named Canal Field. A spacing program of one well to 20 acres has been adopted.

●

The deep producing zone in the Kemp City (KMA) field, Wichita and Archer counties, Texas, has received several further extensions during the last month. The most significant is No. 1 Hodges of the Burk Royalty Company, which extended the field three-fourths of a mile southeast into territory previously regarded as unlikely to produce. The total depth of the well is 3924 ft. in sand topped at 3899 feet. The proved area on December 14 was approximately 44 square miles.

●

Possibility of helium production in Hunter Valley, Canada, has aroused the interest of officials of Alberta and of the Dominion government. Hunter Valley Oil Company, Ltd., discovered high-pressure non-inflammable gas at a depth of 8282 ft. in their well 65 miles west of Olds, Alberta, Canada, just before shutting down for the winter. The nature of the gas will not be positively determined until March when the well will be re-opened. Helium is found in small quantities in wells in Turner Valley, but carbon dioxide and nitrogen seldom are found there.

●

T. D. Humphrey's No. 1 Jeffery has opened a new pool in Young County, Texas, seven miles northeast of Graham. Initial production was estimated to be 1500 bbl. daily, from a total depth of 3932 feet. The nearest production is three miles away.

AVERAGE CRUDE PRICES

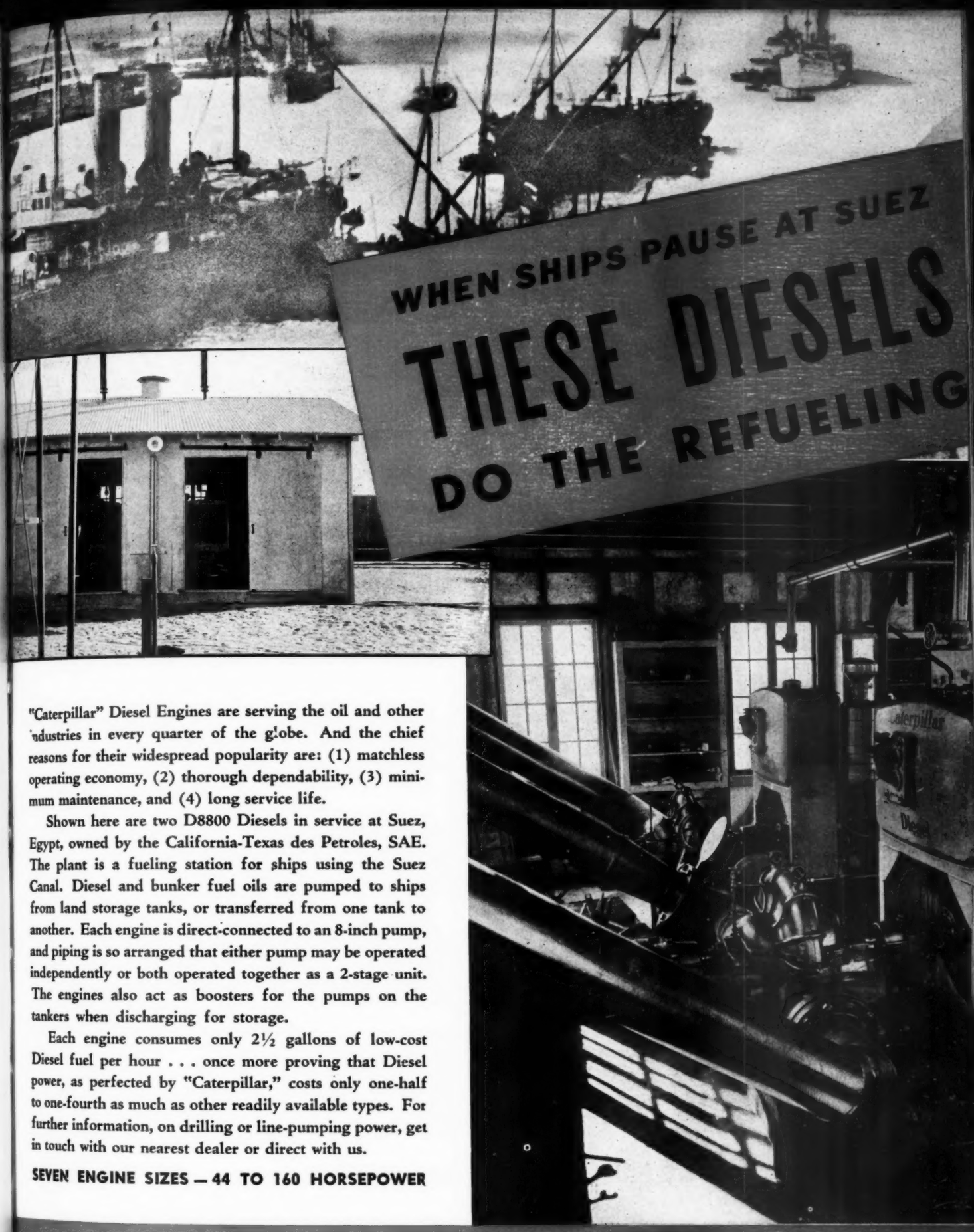
California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70- .90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.40
Indiana	1.12
Ohio	
Lima	1.25
Michigan	1.27
Pennsylvania	
Bradford	2.20
Southwest	1.88
Eureka	1.82
Buckeye	1.70
Corning	1.27
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Int. Calculations (December)	Week Ended Dec. 4, 1937	Week Ended Oct. 30, 1937	Week Ended Dec. 5, 1936
Oklahoma	588 800	556.100	586.750	529 100
Kansas	186.000	168.800	185.600	160.200
Panhandle Texas	.....	67,700	79,000	62,050
North Texas	.....	72 350	73,200	65,700
West Central Texas	.....	33,450	34.700	33,600
West Texas	.....	190 050	217 350	157 650
East Central Texas	.....	91 400	110.200	83 900
East Texas	.....	416 900	482 950	444.000
Southwest Texas	.....	240 600	268,500	175,000
Coastal Texas	.....	191,900	204,900	153,950
TOTAL TEXAS	1,399 800	1,304 350	1,470 800	1,175 850
North Louisiana	.....	74.900	76,250	79,700
Coastal Louisiana	.....	171,400	167,750	159,300
TOTAL LA.	244 000	246.300	244,000	239,000
Arkansas	33,900	44,100	48,650	27,700
Eastern	126,200	137,000	133,300	114,900
Michigan	51,800	53,750	54 300	20,700
Wyoming	57,100	48 700	57,400	46,600
Montana	15,800	15,750	17,650	18,100
Colorado	4 400	4 300	4,150	3,400
New Mexico	104,100	104,750	103,350	82,650
TOTAL EAST OF CALIF.	2,811,900	2 683 900	2 905,950	2 427,200
California	679,400	703,100	697,000	573,000
TOTAL U. S.	3,491,300	3,387,000	3,602,950	3,000,200



WHEN SHIPS PAUSE AT SUEZ
THESE DIESELS DO THE REFUELING

"Caterpillar" Diesel Engines are serving the oil and other industries in every quarter of the globe. And the chief reasons for their widespread popularity are: (1) matchless operating economy, (2) thorough dependability, (3) minimum maintenance, and (4) long service life.

Shown here are two D8800 Diesels in service at Suez, Egypt, owned by the California-Texas des Petroles, SAE. The plant is a fueling station for ships using the Suez Canal. Diesel and bunker fuel oils are pumped to ships from land storage tanks, or transferred from one tank to another. Each engine is direct-connected to an 8-inch pump, and piping is so arranged that either pump may be operated independently or both operated together as a 2-stage unit. The engines also act as boosters for the pumps on the tankers when discharging for storage.

Each engine consumes only 2½ gallons of low-cost Diesel fuel per hour . . . once more proving that Diesel power, as perfected by "Caterpillar," costs only one-half to one-fourth as much as other readily available types. For further information, on drilling or line-pumping power, get in touch with our nearest dealer or direct with us.

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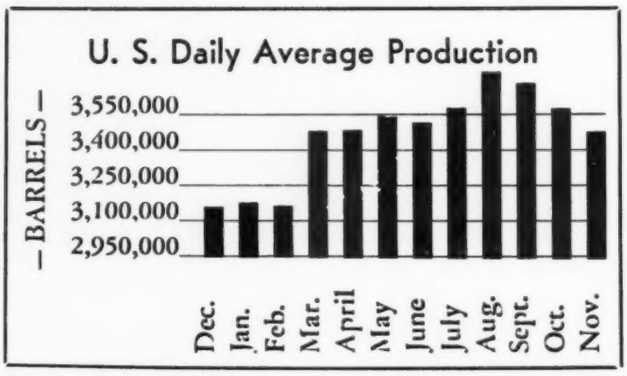
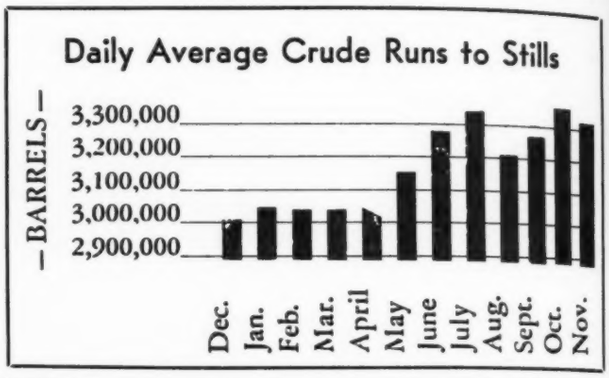
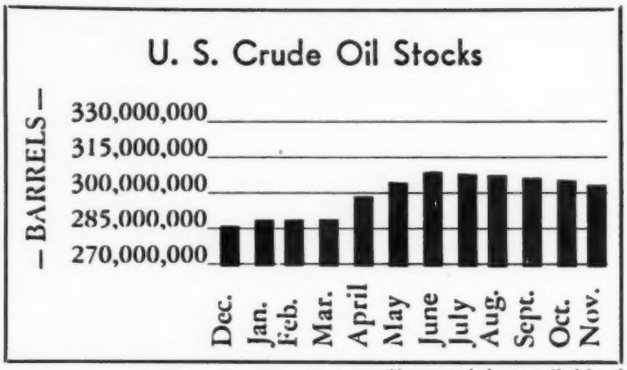
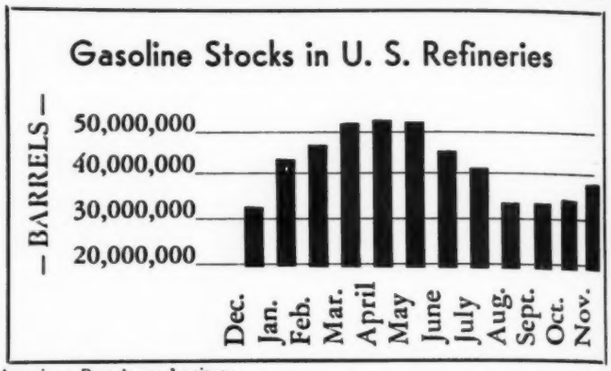
Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for November, 1937

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	264	259	35	86	3500-3700	2	40	Rotary
Duval County	53	45	15	50	1554-2900	2	22	Rotary
Archer County	23	12	2	8	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	80	78	55	178	1700-3900	2	40	Rotary
Refugio County	17	17	3	13	4900-5900	2	38	Rotary
Nueces County	31	29	18	56	3922-5878	2 or 3	21-54	Rotary
Winkler County	39	39	11	25	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	35	35	4	30	4230-4361	2	16-24	Rotary
Oklahoma								
Oklahoma City	5	5	1	4	6450-6682	3	39	Rotary
Fitts Pool	34	29	7	15	1800-4488	2 or 3	38	Rotary
Osage County	13	9	3	20	380-2850	2	37.5-40	Rot.-Cab.
Kansas								
Russell County	45	42	13	50	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	28	22	7	37	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	5	5	2	8	3300-4375	2 and 5	42-48	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	41	40	12	49	5950-6450	3	39	Rotary
New Mexico								
Lea County	45	43	15	115	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	1	1	3	15	8300-8730	3 or 4	40	Rotary
Wilmington	24	24	21	25	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for November, 1937

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1936 (In Barrels)
	November	October	November	October	November	October	November	October	November	October	
Arkansas	24	19	19	15	20	27	15	19	59	62	10,461,000
California	103	150	95	128	155	169	114	140	259	249	214,883,000
Colorado	1	6	0	0	....	....	1	2	36	37	1,670,000
Illinois	72	96	54	62	....	....	....	....	....	....	4,452,000
Indiana	22	15	12	7	....	....	2	2	32	28	795,000
Kansas	263	298	209	236	192	303	64	74	369	429	58,226,000
Kentucky	117	105	77	66	....	....	16	15	90	84	5,653,000
Louisiana	104	96	74	76	104	129	46	47	236	267	79,980,000
Michigan	83	100	63	72	84	99	54	60	173	175	11,852,000
Mississippi	4	....	0	....	....	....	4	5	13	12	Gas Prod.
Montana	17	28	14	26	....	....	4	5	64	71	5,632,000
New Mexico	53	67	49	60	....	....	21	28	163	161	27,134,000
New York	....	....	....	....	....	....	....	....	....	....	4,63 ,000
Ohio	136	144	90	102	....	214	67	68	218	221	3,834,000
Oklahoma	216	254	164	194	216	214	48	53	381	392	206,082,000
Pennsylvania	....	....	....	....	....	....	....	....	....	....	15,830,000
Texas	1199	1516	997	1237	1116	1625	404	471	1537	1741	391,097,000
West Virginia	123	100	112	82	....	....	32	37	205	202	3,903,000
Wyoming	10	10	9	6	....	....	10	10	72	69	13,650,000
Total	2552	3004	2038	2369	1887	2566	902	1036	3907	4200	993,942,000

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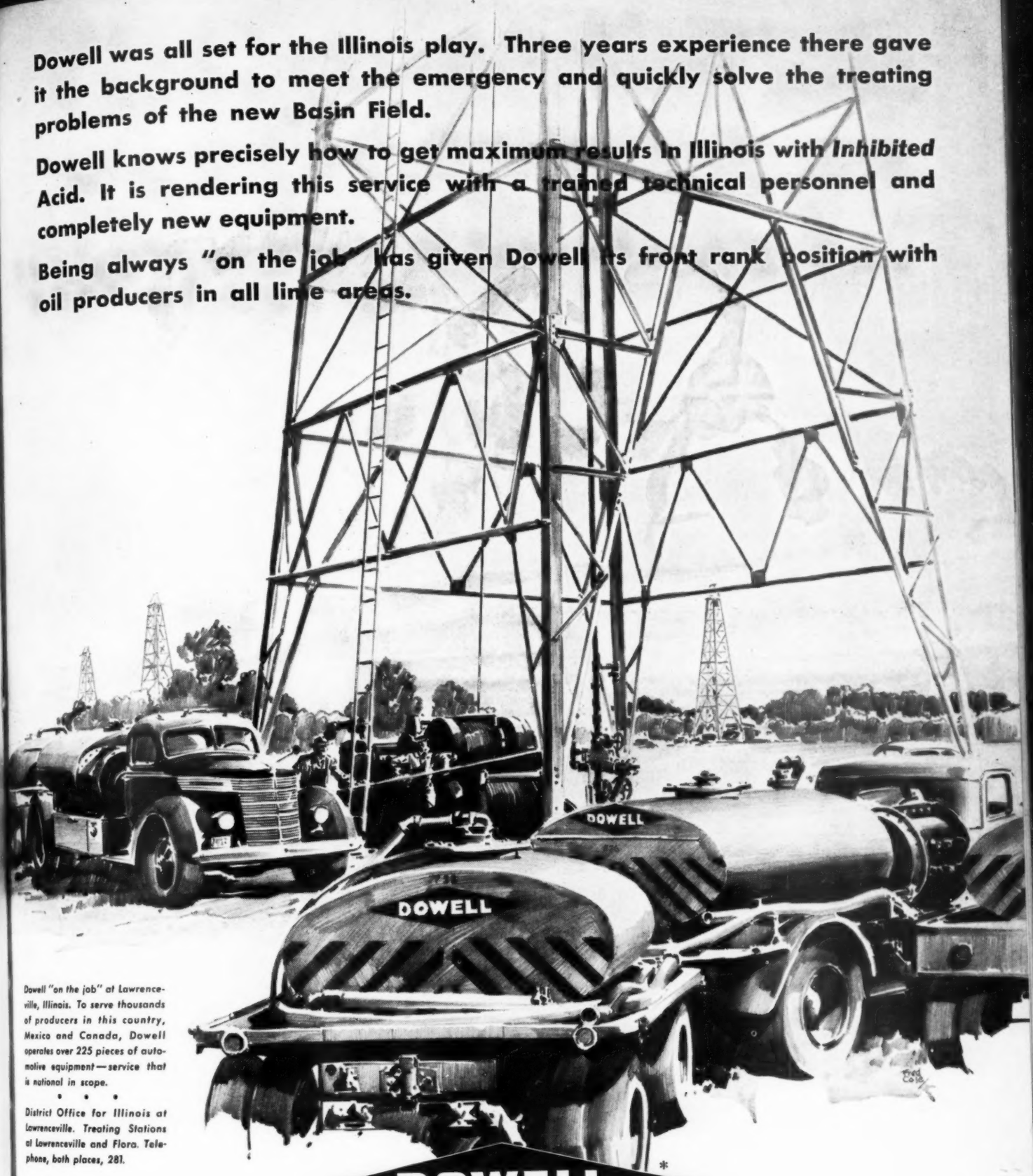
Being always "on the job" has given Dowell its front rank position with oil producers in all line areas.



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OIL AND GAS WELL CHEMICAL SERVICE

Progress of Major Pipe Line Work

AS an initial step in supplying Chattanooga, Tennessee, with natural gas to replace the artificial gas now used, the city council recently granted to the Chattanooga Gas Company a new franchise valid for 40 years. This franchise replaces one that had 16 years yet to run. The natural gas probably will be procured from the Southern Natural Gas Company, and it will be necessary to lay an 80-mile gas pipe line to make the connection.

●

The Cities Service Gas Company is constructing a gas booster station in the Depew field of Oklahoma. Three 80-hp. gas engines and compressors are being installed to boost the gas pressure from the wells in the field to sufficient pressure for injection into the main line. Pressures in the Depew field have declined to such an extent that the wells no longer will produce against main-line pressures. The new station will make it possible again to handle gas from the field.

●

The Amsco Pipe Line Company has completed a 4½-in. pipe line 12 miles in length, extending from the Luby field, Nueces County, Texas, to the company's Clarkwood station, which in turn connects with the company's terminal on the Corpus Christi ship channel. This gives the field, discovered several months ago by the Seaboard Oil Corporation of Delaware, its first pipe line outlet. The capacity of the line is 4500 bbl. daily.

●

The White Deer Pipe Line Construction Company, Oklahoma City, Oklahoma, has been given the contract for laying approximately 30 miles of gathering lines to be used in connection with a gasoline plant to be erected for the Barnsdall Oil Company near Odessa, Texas. Of the total mileage, 27 miles of the pipe varying in diameter from 2 in. to 10 in. will be oxy-acetylene welded by the Lindeweld method.

●

Building of the Keystone Dam in Nebraska, a PWA project, has necessitated the Stanolind Pipe Line Company taking up 23 miles of 12-in. pipe in the North Platte River Valley between Lewellen and Keystone. The pipe, plus 4000 additional feet, was relaid around the area in which the dam is being constructed. The latter is being built at a cost of $30,000,000 to provide electric power and for the purpose of irrigating the Platte River Valley.

●

The Lone Star Gas Company is laying 19 miles of 18-in. pipe line to connect gas wells in the Buffalo, Texas, area with the company's 12-in. carrier from the Long Lake field to Central Texas. The tie-in will be made near the town of Buffalo. Construction work will be in charge of the engineering department of the Lone Star.

The Lone Star Gas Company recently purchased extensive gas holdings in the Buffalo area from the Shell Petroleum Corporation.

The J. F. Pritchard Company has been awarded a contract for the laying of approximately 22 miles of pipe line near Billings, Oklahoma, for the Continental Oil Company. Diameter of the pipe varies from 4 in. to 20 inches. The joints will be oxy-acetylene welded by the Lindeweld method.

●

The Cities Service Gas Company turned gas into its new Edmond, Oklahoma, line recently. This 10-in. line extends from the Oklahoma City 20-in. main line to the Edmond field in section 31-14-3w, Oklahoma County. Approximately 12,000,000 cu. ft. of gas is being handled daily through the extension.

●

The Michigan Public Utilities Commission recently granted permission for the Gas Corporation of Michigan to borrow 100,000,000 cu. ft. of gas this winter from the Consumers Power Company to prevent a shortage at Mount Pleasant, Clare, and Rosebush during months of peak consumption. Approval also was given the organization of the Utilities Pipe Line Corporation and the laying of a 14-mile pipe line to connect Gas Corporation of Michigan lines with that of the Consumers Power Company, bringing gas from the Broomfield area. The line was completed on November 29.

Charles M. Sturkey and Warren J. Sommerville of Mount Pleasant, J. L. Boone of Ludington, and the Gas Corporation of Michigan are the incorporators of the Utilities Pipe Line Company.

●

The Mississippi River Fuel Corporation is erecting a gas booster station seven miles south of Newport, Arkansas, on its line going to St. Louis, Missouri. The contract has been awarded to the J. F. Pickett Engineering Company of Kansas City, Missouri.

●

A loop is being laid to the Turner Valley, Canada, field's only pipe line outlet, which will increase the capacity of the carrier by 300 to 400 bbl. daily. The line is to Calgary, a distance of 50 miles. The existing capacity of the line is 10,000 bbl. daily, and even with a 300- to 400-bbl. increase, pipe line facilities still will be inadequate, as the potential of the wells in the field totals 21,000 bbl. daily. As a consequence there is considerable talk among independent operators of laying a coöperative line from the field to High River, a distance of 14 miles, whence the crude would be transported by rail to refineries in neighboring provinces.

●

H. C. Price Company, Bartlesville, Oklahoma, announce they have been awarded the contract by Ostrom Realty and Construction Company for the electric welding of approximately 160 miles of 8-in. for the Shell Petroleum Corporation from the Illinois-Indiana line to the Indiana-Ohio Line.

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 72.8 Percent **Central Division, 74.7 Percent** **Eastern Division, 80.7 Percent**

THE Amsco Refining Corporation, Corpus Christi, Texas, has announced plans for a 6000-bbl. addition to its present refinery, increasing its capacity to 10,000 bbl. daily. Work has begun on the project, which will be in operation by March 1, 1938, at the latest, according to officials of the company. It has not been announced what type of unit will be installed, but it is believed it will be one for the manufacture of gasoline. The plant at present is producing painters' naphtha and burning oils.

●

The Panhandle Producing and Refining Company has installed a new Dubbs cracking unit in its Lueders, Texas, refinery. The new unit is of 1000-bbl. daily capacity and crudes from the Rotan and Avoca fields will be processed.

●

A 12,000-bbl. capacity acid-treating unit is being installed at the Port Arthur, Texas, refinery of the Gulf Refining Corporation.

●

The Big Spring, Texas, refinery of the Cosden Petroleum Corporation is being enlarged by the addition of a 7500-bbl. cracking unit, doubling the cracking capacity and increasing the cracking and skimming capacity to 17,000 bbl. daily. The installation will be made by April 1, it is expected.

●

The Southwestern Oil and Refining Company is increasing the capacity of its Corpus Christi, Texas, refinery to 8000 bbl. by the addition of a 5000-bbl. unit to the plant. The installation is scheduled for completion by the middle of February.

●

The Post Refinery, Post, Garza County, Texas, owned by F. E. Patton, will be dismantled and moved to Rotan in Fisher County, it is announced. The capacity of the plant is 600 bbl. daily. Crude will be run from the Robinson field, which has no pipe line outlet, for processing in the plant.

Imperial Oil, Ltd., is increasing the capacity of its refinery at Regina, Saskatchewan, Canada, by 3000 bbl., making the total capacity of the plant 7000 barrels. It is expected to be completed in June. The company also will add a new cracking unit to its refinery at Calgary.

●

The Republic Oil Refining Company is adding a combination skimming and cracking unit to its refinery at Texas City, Texas. The unit will have a daily capacity of 10,000 bbl. and will increase the throughput to 23,000 barrels. Completion is expected by the latter part of May.

●

The Magnolia Petroleum Company has been granted permission by the Oklahoma Corporation Commission for the erection of a carbon black plant near Stonewall, Oklahoma, in the Fitts field. The plant would have a daily capacity of 24,000,000 cu. ft. of gas, taking residue gas from the company's natural gasoline plant in the field.

●

A 500-bbl. refinery, to be completed in January, is being constructed in the South Turner Valley field of Canada by Economy Oils, Ltd. The location is on the Century lease, 28-18-2w5.

●

Universal Oil Refining Company of Amarillo, Texas, has announced plans for construction of a new refinery at Pueblo, Colorado. Jack Harris is president of the company and H. S. Newman superintendent.

●

The Premier Oil and Refining Company, Longview, Texas, is constructing a 3000-bbl. skimming plant in the Cotton Valley field, Webster Parish, Louisiana. An absorption-type natural gasoline plant will be erected in conjunction with the refinery, it is announced. Completion of the project is expected by February 1.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks

Week Ended December 4, 1937

A.P.I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	576,000	86.1	18,314	14,526
Appalachian	88.4	90,000	69.8	2,782	1,064
Ind., Ill., Ky.	92.4	421,000	86.1	10,362	7,241
Okla., Kans., Mo.	84.7	267,000	69.7	6,558	3,822
Inland Texas	56.6	106,000	52.7	2,117	1,834
Texas Gulf	95.7	694,000	87.1	9,877	11,781
La. Gulf	96.6	145,000	86.3	1,732	3,436
No. La.-Ark.	63.7	45,000	77.6	426	539
Rocky Mt.	69.7	48,000	77.4	1,523	650
California	90.9	503,000	68.2	12,682	73,176
Reported	89.0	2,900,000	78.3	66,373	118,169
Est'd Unreported	.....	330,000	.....	3,820	3,150
*EST'D TOTAL U.S. Dec. 4, '37	.....	3,230,000	.....	70,193	121,319
*EST'D TOTAL U.S. Nov. 27, '37	.....	3,325,000	.....	68,544	121,616
U.S. B. of M. *Dec. 4, 1936	.....	**3,002,000	.....	59,326	110,913

*Estimated Bureau of Mines' basis.

**December, 1936, daily average.

REED ROTARY DRILLING TOOLS

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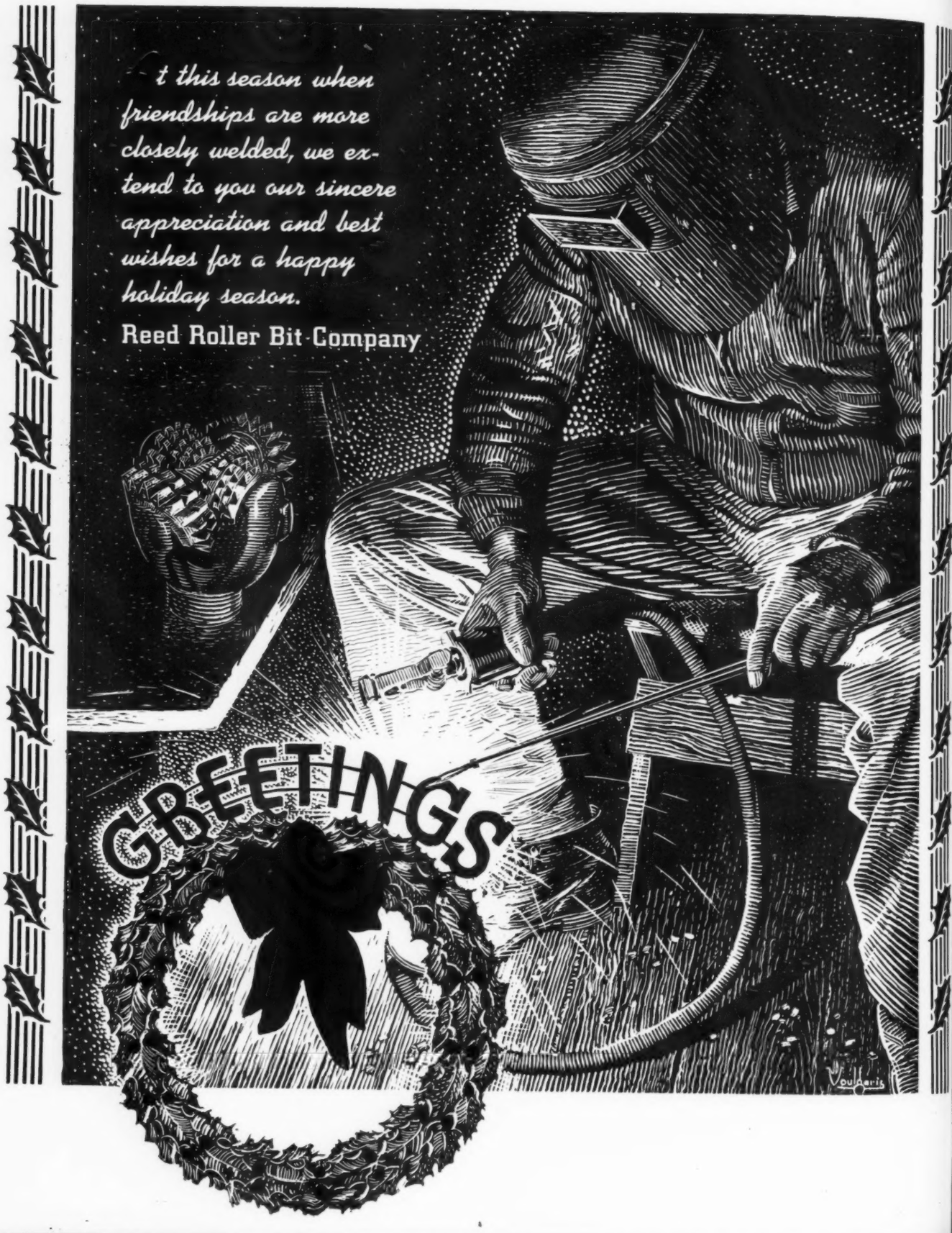
At this season when friendships are more closely welded, we extend to you our sincere appreciation and best wishes for a happy holiday season.
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GREETINGS

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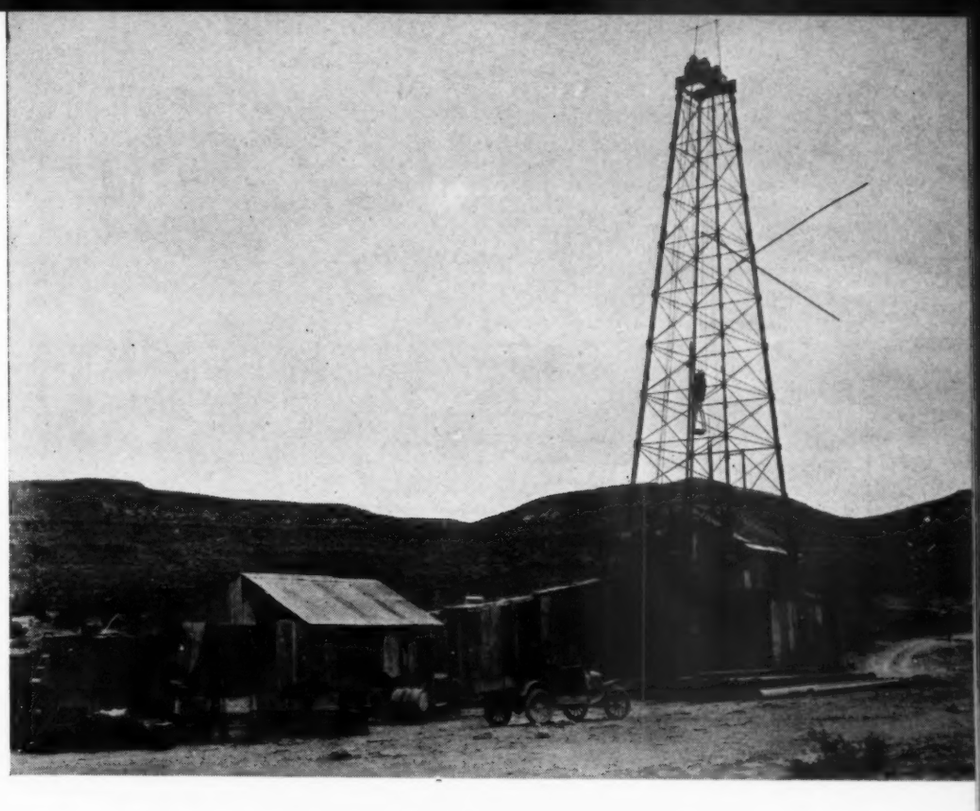


The old familiar cable-tool rig with its extended belt and engine houses

By

LEO H. TOWERS

Improvements in Methods and Equipment Noted Even Though Number of Units Decreases

Developments in Modern Cable-Tool Drilling

THE number of cable-tool drilling rigs in operation has been considerably reduced in the last ten years; however, during that time decided improvements have been made in the entire range of equipment from the smallest cable-tool spudding unit to the largest standard rig.

A summary of the developments in this newer equipment compared with the old, such as was used to drill the old Burbank field of Oklahoma during the years 1918 to 1924, includes:

1. Increased portability of all types of cable-tool drilling units.
2. Development of spudders.
3. Increase in the use of internal combustion engines as prime movers.
4. Unitization of several types of drilling machines to facilitate rigging-up.
5. The combination of cable and rotary operations.
6. Improved fishing tools.
7. Improved or eccentric drilling bit, reducing the number of strings of casing necessary.
8. Use of whipstocks.
9. Use of colloidal mud behind casing.
10. Improved design in high-pressure control equipment permitting the drilling and completion of wells producing large volumes of gas and oil without loss of the fluid, and affording safety to crews and equipment.
11. Use of automotive transportation in moving equipment and men.
12. Cementing of casing, not attempted in early operations.

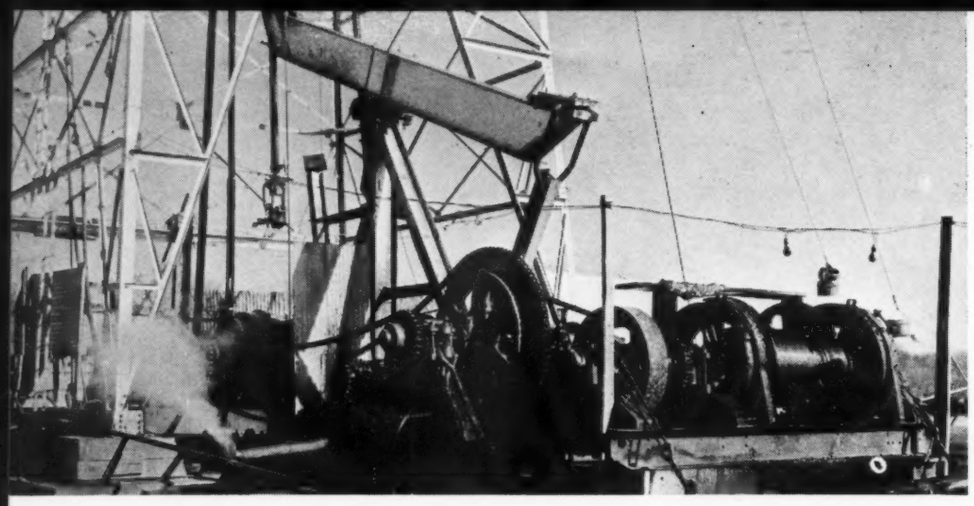
Although cable-tool operations in the Mid-Continent area have decreased in number since the opening of the Seminole pool, numerous other fields have seen increased cable-tool activity. Among these the Bradford, Pennsylvania, water-drive fields have the most numerous as well as most consistent cable-tool operations. Approximately 300 cable-tool rigs of various kinds have been running in that area for several years redrilling old leases or drilling the "five spot" wells. Recently water-drive operations have been extended to the Mid-Continent area near Nowata, Bartlesville, and Tulsa in Oklahoma, and near Wichita Falls in Texas.

For the shallow work in water-drive areas spudders generally are used. These units afford economy by full, rapid removal to new locations and by time saved during actual drilling operations by eliminating such duties as hitching and unhitching from the temper screw, clamps, and beam, which are necessary on a regular machine or standard rig. Every conceivable kind of drilling machine and power unit has been used in the Bradford area, even homemade machines and auto-engine power units. The larger producing companies, however, have modern, improved machines unitized to give portability. Tractors are employed to move the sections. One operator states that a National machine that he had unitized moved to and drilled four holes having a total footage of 5600 ft. in 26 days' time, a performance that is a good record for any type rig.

Another very active cable-tool territory is the Kanawha County area of West Virginia. Large gas reserves at a depth of 5000 ft. were discovered 18 months ago. Recently, 104 rigs were in operation in this field. Multi-cylinder gas engines are employed as power units, and most of them are equipped with either a countershaft or reduction gear unit. A few rigs are still driven by steam engines. Drilling tools are like those used years ago; for instance, a 650-ft. cracker or manila cable is used on the bottom of the wire line. Of all the items on the entire rig the only modern pieces of equipment are the power unit, the slip-type casing spider, slip-type casing elevator, temper screw, and clamps. Seventy to 110 days are required to complete these 5000-ft. wells, which produce 5,000,000 to 25,000,000 cu. ft. of gas daily. The hilly terrain, the small amount of casing required, and the low drilling costs per ft. preclude the possibility of rotary drilling methods being employed in this territory. Casing strings are as follows:

10-in. to 500 ft.
8⅝-in. to 2200 ft.
7-in. or 5½-in. to 4900-5000 ft.

Absence of water sands and caving



A modern cable-tool rig showing the entire assembly mounted as one unit for portability

formations permits drillers in this area to carry open hole from 2200 ft. to 5000 feet.

Two years ago the United Fuel Gas Company drilled a test well in Roane County, West Virginia, to a depth of 9104 ft. using cable tools. A valveless twin-cylinder gas engine was used as a power unit and the rig was equipped with a hydraulic brake and double brake wheels on the bull wheel shaft. Casing was set in this well as follows:

18⅝-in. to 624 ft.
16-in. to 1001 ft.
13⅜-in. to 1947 ft.
10¾-in. to 4131 ft.
8⅝-in. to 5221 ft.
7-in. to 6886 ft.

Several other deep holes have been drilled in West Virginia and a major operator last year drilled a deep test in Virginia, on which a tapered wire line was used.

Some of the most modern cable-tool drilling units are used by deep water-well contractors around Chicago, St. Paul, Minneapolis, Des Moines, and other cities in that area. One contractor begins with a 30-in. hole and completes the well at approximately 2200 ft. with a 12-in or 10-in hole. Long bits and 40-ft. stems are used. One of these contractors recently began to use 18-in., 15-in., and 12-in. bits provided with boxes instead of pins. This innovation, which has proven to be very beneficial, was tried because so many pins were knocked off drilling hard rock that the collars of the long bits would be used up before the blade was worn away. A double-pin substitute is used to connect the stem box to the box on the bit. If a pin breaks the sub provides a good long neck for which to fish. It is not necessary to haul the stem to a shop for repairs. A new sub is placed in the string of tools and drilling continued.

Eccentric Drilling Bit

An outstanding item among modern cable drilling tools is the eccentric bit developed by one manufacturer. The bit provides a means of carrying a string of casing through several water sands. The bit construction permits the bit to go through the casing and yet drill below the casing shoe a hole one inch larger in diameter than the next larger size paddle bit would drill. This allows sufficient clearance for casing couplings. The object of this bit is to permit carrying a string of casing to a greater depth. Its operation briefly is as follows: A 12-in. hole is drilled to a water sand. The 10¾-in. casing is then run and seated on a shoulder or bottom. A 10-in. paddle bit is put on the string and a 10-in. "rat-hole" drilled to a depth of 14 ft. below the casing shoe. The paddle bit is replaced by the eccentric bit, and its action "funnels" the hole out to 13-in. diameter beginning 14 ft. below the shoe. After it has begun making the full-sized hole it drills a wet hole faster than a regular bit due to the fact that it is only about half a bit, which permits it to drop faster and also decreases the tendency to stick. When the next water formation is reached the 10¾-in. casing is picked up, the 14-ft. shoulder reamed out, and the casing lowered to shut off the second water stratum. This procedure is repeated as additional water sands are encountered. Before the casing is lowered Aquagel or other mud is placed in the hole and forced behind the casing to facilitate raising and lowering it. Comment by drillers indicates that one string of pipe might be carried 3000 ft. or 4000 ft. by this method.

As an example of the possibilities of this bit in reducing the amount of casing required, the drilling of the old Burbank pool is compared with the drilling of the South Burbank field. The South pool, drilled in 1934, has 200 wells and is situated four or five miles from the old pool. The casing programs of the two pools are as follows:

Casing Size	*Old Burbank*	*South Burbank*
20-in.	100 ft	
15½-in.	900 ft.	
12½-in.	1400 ft.	38 ft.
10¾-in.	1800 ft.	1424 ft.
8⅝-in.	2400 ft.	2750 ft.
7-in.	3000 ft.	2834 ft.

Note that in the South pool the hole was carried to 1400 ft. before setting the first water string and from 1400 ft. to 2750 ft. before setting the next string. This saving was so desirable that drilling contracts contained a clause to the effect that eccentric bits were mandatory for drilling each well in this pool.

The eccentric bit is made in 5 3/16-in. to 18-in. sizes, inclusive. So far it has been used in many localities in Michigan, Oklahoma, Kansas, and Texas. Drilling dry hole in the interim between setting the casing through one water sand and entering the next water stratum speeds up the drilling. More hole can be made before pulling out due to the fact that the bit will not mud-up and stick even in a thick mud. A 24-ft. stem replaces the usual 30-ft. one. The bit is dressed with a form and bit ram.

Whipstocks are used with cable tools in many wells. They are used not for directional drilling but to drill past tools or casing or to make a window through the casing some distance above a producing level that was passed up when the well was drilled originally. This operation is accomplished by fastening a regular bit to the top of the whipstock before lowering into the hole. The bit is dressed to the approximate shape of a ripper knife on one lug only, the other lug being flattened and riveted to the whipstock. In one particular instance a special whipstock was used. Its method of operation is as follows: After shearing from the whipstock and drilling out the window the bit reaches the bottom of the taper of the whipstock. Here it shears a cast-iron plug releasing grease from a cylinder. This permits the whipstock to telescope a distance of three ft. and brings the top down to the point where a full-sized window has been drilled through the casing, eliminating the possibility of bailer or tools sticking.

Cementing of casing has been very beneficial in modern cable-tool drilling. It has eliminated the entry of water behind casing shoes and partially eliminated the collapse of casing. In shooting and acidizing operations, cementing affords a factor of safety and eliminates hazards formerly prevalent.

In modern cable-tool drilling the available casing is heavier and of better quality than that used in the old-time wells. Threads and couplings and the grade of steel are much improved. There is no need to plug a hole and skid a rig because of an unsuccessful fishing job. Whipstocking and drilling past 1100 ft. of 7-in. casing was

accomplished a few years ago in Oklahoma. Three sets of tools were lost in a well in New Mexico. A whipstock with a combination socket in its base was run on a string of pipe. Drilling past the three sets of tools permitted the pulling of the pipe and whipstock, and also with them the three strings of tools.

Casing is handled and landed with modern slip-type spiders and elevators without the former danger of dropping the pipe and plugging the hole.

In past years numerous cable-tool holes were drilled a foot or more too deep and encountered water, thereby ruining the well. Today a squeeze job using a modern packing head would shut off the water whether it be above, below, or in the oil formation.

Pressure control equipment has been a big aid in modern drilling. In the Texas Panhandle, for instance, its use has permitted the completion of gas wells of 60,000,000 to 120,000,000 cu. ft. daily capacity without hazard to men or equipment.

Portable drilling-in units have a decided advantage in following the rotary, which is moved after the oil string is run and cemented. These units are in use in many areas, notably in Kansas where it is preferable to drill-in with cable tools because of the low pressure of the producing formations.

Modern cable-tool core barrels have retrieved numerous cores used in determining porosity, permeability, and oil content of sand in many areas, particularly in the water-flood regions.

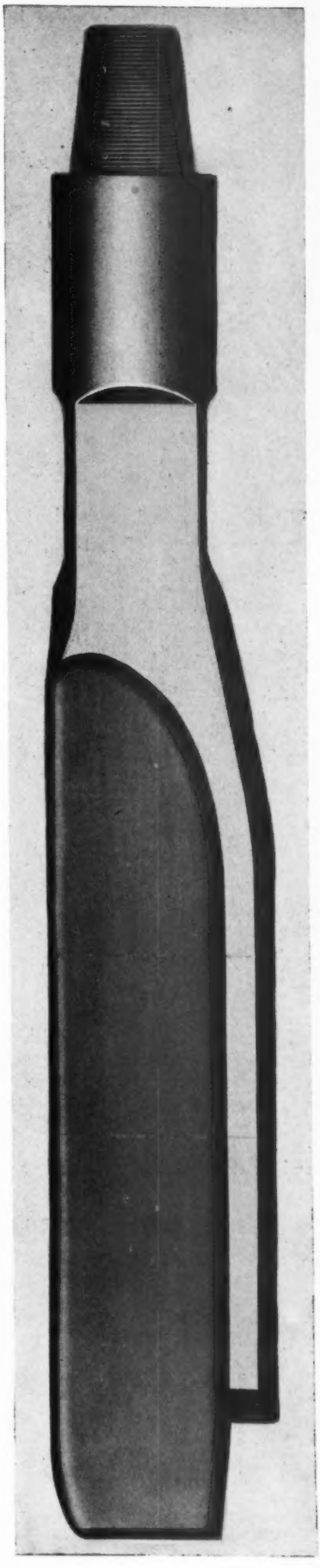
Combination rotary and cable-tool rigs have proved very efficient in certain areas. A jack-shaft rotary employed in West Texas consists of a regular cable-tool rig provided with a jack shaft ahead of the band wheel to drive the rotary table.

A recent innovation has been the unitizing of bull wheel assembly, samson post and beam, sand reel, and engine into one easily portable and efficient assembly. In West Virginia and other hilly areas this is particularly advantageous because the outfit requires less space than the conventional rig, so saves blasting and other work in preparing the location. This design uses a chain and sprocket drive from the engine.

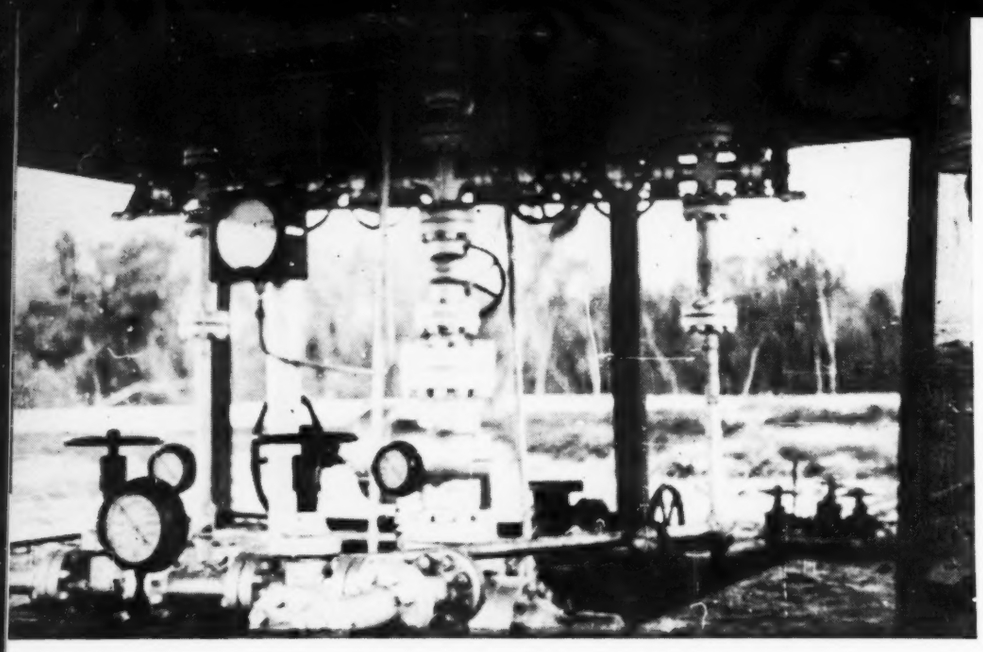
Internal combustion engines as prime movers are gaining in favor and their use adds to the portability of the drilling unit. Gas, gasoline, or Diesel power is used depending upon the availability of the fuel for each kind of engine.

One resourceful Mid-Continent producer recently adapted an inexpensive power unit to a drilling machine in an unusual way. He observed that on various machines using an automotive engine direct-connected by belting to the bandwheel a fluctuating power resulted that did not provide correct pick-up and drop to the tools, so he set about to correct this trouble. It was due to the fact that the automotive engine had such a small flywheel and of necessity had to operate at a low speed. His unit was constructed in the following manner: From an old gas engine bed plate the cylinder, connecting rod, and crankshaft were removed. A straight shaft was substituted, on one end of which was installed a set of steam engine flywheels with balances. On the opposite end was placed a belt pulley of approximately the same diameter as the flywheels. Adjacent to the flywheels and connected by a flange coupling was an ordinary 18-in. reversible clutch and outboard bearing. On the front of the engine base were mounted a pair of rails across which was set a V-8 automotive engine with its clutch and transmission, a texrope pulley of 14-in. diameter, and an outboard bearing. The entire assembly was mounted on a pipe skid frame that also served as an exhaust chamber for the engine. Power was transmitted from the engine to the flywheel pulley and from the reverse clutch pulley to the band wheel. The momentum of the flywheel gave suitable drilling motion. The flexibility of power and speed made it available for drilling, fishing, and casing operations. Gas consumption at six-ounce pressure was small. The engine was equipped with battery starting. A small drum of water and anti-freeze solution served as engine cooling water. This is but one example of the latest trend in this field. The same unit could be used to pump beam wells or to drive bandwheel or geared powers at a nominal cost.

Cable-tool operations are not so numerous as in the past; however, in some areas there is a definite need for the continued use of these tools. The Argentine government owns and operates 40 cable-tool rigs in addition to its rotary rigs. Some of their cable-tool rigs are electrically driven from a central power plant. In at least one water-flooding area in Oklahoma the use of electrically-powered spudders driven by purchased power is being considered at the present time. Cleaning operations and other well repairs are done with modern cable-tool units even in the deepest wells in all producing areas.



The eccentric bit used to make a hole below the casing large enough to permit the casing being carried beyond one water sand



Close-up view of casinghead connections and pressure gauges

By
DENIS S. SNEIGR

Deep Wells Producing Under H

DRILLING and production problems caused by the unusually high gas pressure in the Old Ocean field in Brazoria County, Texas, are encountered in few other fields. In solving these problems Abercrombie and Harrison have employed special equipment and methods very successfully. The field is being produced safely and economically, and the fact that neither blow-outs nor injuries to workmen have occurred as the result of the high gas pressure is a credit to the methods employed by the operators.

Since the last article on the Old Ocean field appeared in *The Petroleum Engineer* (May, 1937) some noteworthy improvements have been made in the production equipment, resulting in greater efficiency.

The Christmas tree assembly now in general use in this field consists primarily of six chokes and several gate valves of 10,000-lb. test. With this arrangement, the flow of oil and gas can be directed from either or both wings of the Christmas tree. The three chokes in each side of the manifold—one at the inner and one at the outer end of the flow manifold and one at the outer end of a flow wing—reduce the pressure in three stages from approximately 4000 lb. to the working pressure of the separators.

These six special chokes consist of a positive bean on the upstream side and an expansion tube on the downstream side. The dimensions of the parts follow:

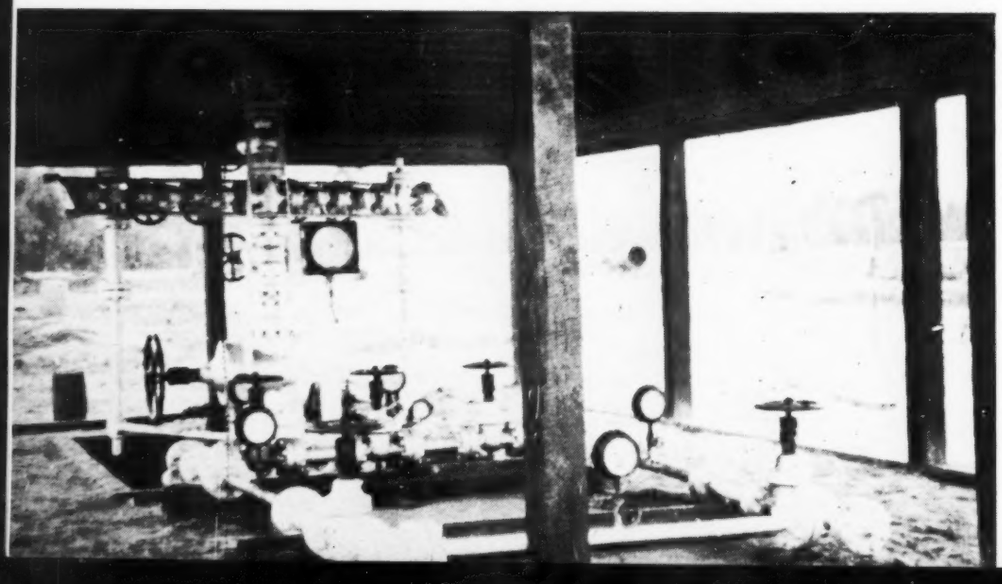
	I.D. Positive bean	*I.D. Expansion tube*
Choke on flow wing	12/64 in.	½ in. to 1⅛ in.
Choke at inner end of manifold	29/64 in.	¾ in. to 1¼ in.
Choke at outer end of manifold	31/64 in.	¾ in. to 1¼ in.

On each lease the heaters, separators, tanks, and power plant are centrally placed. On the Bernard River Land Development Company lease, where four wells have been completed, there are four 30-in. by 11-ft. separators of 1000-lb. working pressure each equipped with two back-pressure valves connected in series. The first valve holds the desired pressure on the separator, and the second valve reduces in two stages the pressure of the relief gas from the first valve. This hook-up serves to prevent freezing.

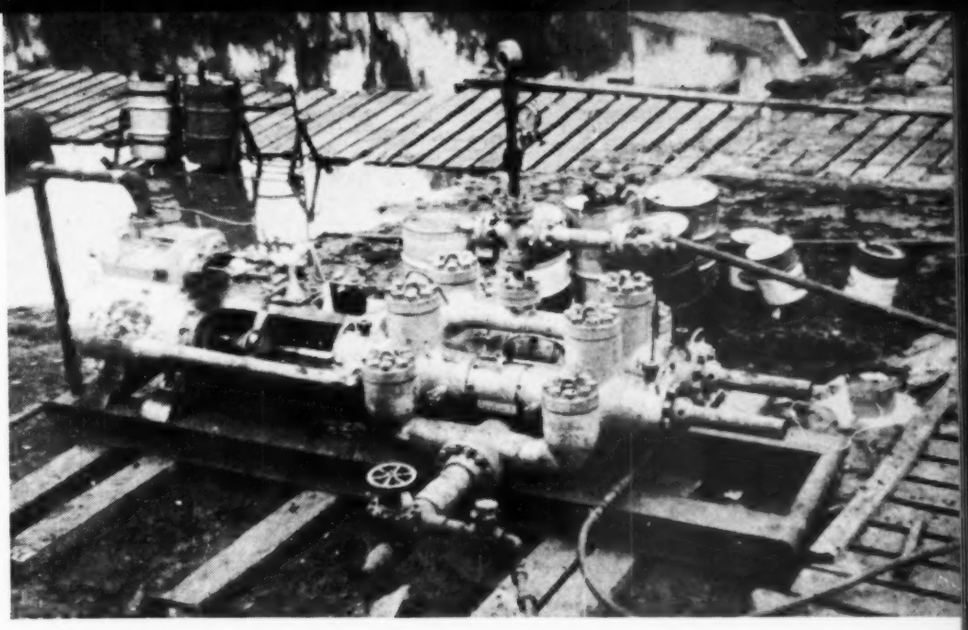
The standard type of spring-actuated relief valve is placed on top of each separator. This valve is set to relieve pressure at 1000 pounds. The shear relief valve, set to relieve pressure at approximately 1350 lb., is situated on the drain pipe of each separator. This arrangement gives a full line opening for relieving pressure. The gas would be released from the top and bottom of the separators simultaneously, thereby providing an additional factor of safety.

These four separators are manifolded so that production from any well or combination of wells may be transferred from one separator to another as desired. Flexibility of the back-pressure control permits variation of separator pressure from 100 lb. to 1000 lb. in order to determine the pressure necessary to attain the maximum production efficiency of any particular well.

Permanent buildings house the separators on each lease. These buildings are equipped with heating coils around the walls to maintain a constant temperature. Correct temperature is an important factor in handling this 55-gravity crude. If heat were applied at one particular point during separation—that is, heating coils within the separator proper—a higher temperature would be required to minimize freezing. On the other hand, this



Another view of casinghead showing arrangement of valves and chokes on Christmas tree and the flow lines from well



Portable high-pressure (10,000-lb. test) mud pump

Special methods successfully applied in Old Ocean field have increased efficiency of well operation, improved flexibility of control, and rendered operations safer

High Pressure Efficiently Controlled

higher temperature would cause a greater loss by evaporation from a crude oil of such gravity. By using the heating coil system in the separator building, this loss is eliminated and maximum production obtained.

In a further effort to maintain a constant temperature in the separator building, the walls are so constructed that sections may be removed during the summer months in order to utilize atmospheric heat; however, the heating coils remain in place.

Field fuel lines obtain gas from an auxiliary line that is tied into the line between the separator and the first back-pressure valve. A reducing valve on the field fuel lines insures a constant pressure on all gas lines carrying fuel for firing boilers on rigs and auxiliary boilers that supply steam for the water pumps and for the pumps moving oil from storage to the loading rack.

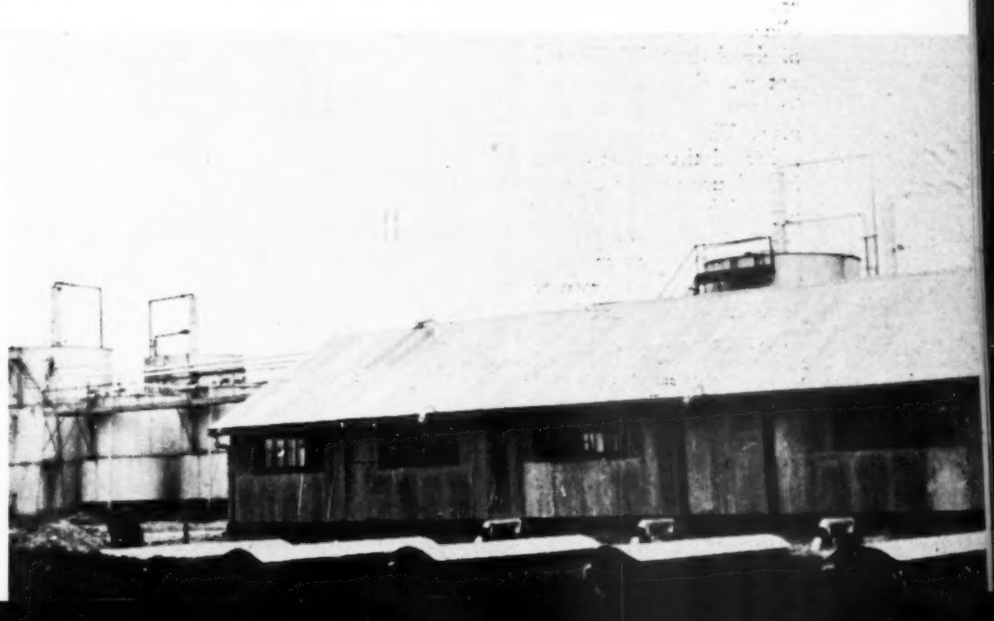
Auxiliary boilers also provide steam for the four heaters on the flow lines between the separators and the wells. The four heaters on the Bernard lease are connected in parallel and each heater is controlled by a separate valve. The old hot-water heater that was in use when the No. 3 Bernard well was completed has been eliminated. These new heaters are steam jackets surrounding the flow lines and are situated near the separator building. To maintain a more nearly uniform temperature, sheet-metal covers protect the heaters from the elements.

The three principal advantages of this production system are flexibility, production efficiency, and safety.

Two other pieces of special equipment at Old Ocean that add to the safety of operations are the small Christmas tree used on the mud line when a well is drilling and the 10,000-lb.-test portable mud pump, a specially-built unit for use in any part of the field. In an emergency the pump can be used to control high pressure encountered in drilling wells, or, if such an occasion should arise, to kill a producing well. This pump can be operated in series with the two standard mud pumps on a well or it can be operated separately. The necessary connections are provided on all rigs.

Special rules recently adopted by the Railroad Commission pertaining to the Old Ocean field are interesting. The spacing rule provides that wells shall be spaced 1320 ft. apart. The rest of the order is concerned chiefly with safety provisions. For example, the rule pertaining to the casing program provides that three strings of pipe shall be set in each well. The surface casing must be new pipe of 1200-lb. test and must be set not higher than 1400 feet. The second string must be new or reconditioned casing and tested to 2100 lb. and must be set at not less than 6500 feet. The oil string must be new pipe of 2600-lb. test. Among the other rules are provisions for Christmas trees of 10,000-lb. test and tubing of not more than 2½-in. size.

Abercrombie and Harrison, planning an extensive and conservative development of the Old Ocean field, have installed several units that serve to increase the efficiency of operations. This field is in a swampy and densely-wooded section of Brazoria County. As the field is developed, it is necessary to clear the land and build roads and bridges. A small sawmill has been installed that utilizes the timber cleared from the land. The main building at Old Ocean houses the production offices, including that of the district clerk and the district superintendent. In this building also are living quarters and a warehouse, the latter being stocked with parts to make emergency repairs on any piece of equipment in the field. A geological laboratory and a gas-testing laboratory also have been installed. A separate building houses the garage, welding shop, and additional living quarters.



The separator building, and, in foreground, the heaters

Cause, Prevention, and Control of Petroleum Fires[1]

A knowledge of the immediate causes of fires is essential to their prevention and control

By JOHN T. HOWELL[2]

IT was not until approximately 13 years ago that our company began organized safety efforts in its operations. The safety staff set up at that time was relatively small and consequently limited in its ability to carry on the work throughout operations so comprehensive and widespread geographically as are ours. Like many other safety groups during that period, our first steps were in the nature of defensive movements, etc., introducing only such safety propaganda and education as the limited opportunities would permit. Within the next few years, up to 1930, this method of carrying on safety work, although showing some very tangible results and reductions in accident frequency and fire losses, still left a great deal to be desired.

Beginning in 1930, the personnel of the safety board was augmented somewhat, and a more militant attitude toward the whole problem was adopted. This consisted of the setting up of machinery to disseminate knowledge of the hazards to the men in the field, through the medium of safety meetings, safety topics, etc. Immediately there was an acceleration of the decline in personal injuries and fires. With respect to fires, however, it soon became apparent that a limit would be very quickly reached, utilizing this means alone, and when that happened interest in the problem among the operating personnel would naturally decline. One other point became definitely obvious. We learned that it was not enough to tell a man that he must be careful else fires would occur in his plant. Their concept of the fire hazard indicated that most of our employees looked upon it as some mysterious thing. The immediate causes of broken bones, sprained muscles, and skinned knuckles are commonly within the knowledge of most men who are subjected to the possibilities of injuries of this kind. The causes and prevention of fires, however, come within the realm of information not ordinarily possessed by the layman.

This presentation is one that the writer devised for our marketing group. Similar presentations, adapted to the needs of the particular group, have been made to the refining, production, and other departments in our operations. In presenting it here we realize that we are probably telling you nothing that you do not already know but we ask that you look at it objectively, from the standpoint of criticising it as a means of supplying something to our operators that will serve as a foundation upon which they can build in the future.

What Is Fire?

The Standard dictionary gives 11 definitions for the word "fire." There are only two that are common: the "friendly" fire and the "unfriendly" fire. We are all familiar with the "friendly" fire and there is no debate on that score. There may be some differences of opinion regarding an "unfriendly" fire. Regardless of that possibility we can agree on the following statement:

"Before we can have fire at all we first must have something that will burn. We call it fuel."

Let us now draw a horizontal line and identify with the word "FUEL":

Fuel

Here we have the base of every fire; something that will burn.

On the table here we have a number of pieces of common fuels, things that burn every day somewhere. Yet I can take this block of wood and hold it over the flame of a burning candle (Fig. 1) and we see it does not take fire. Of course the block is heavy and solid but here is a piece of cloth. We substitute it for the block of wood and the results are the same.

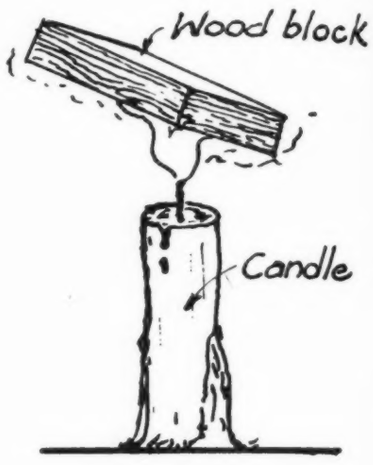


Fig. 1

Now let us try a liquid. In this bottle there is some kerosene. I shall pour some of it out in a pan. The pan is filled to a depth of about ¼-inch. If we hold a match over the surface (Fig. 2) there is no burning. Even when we

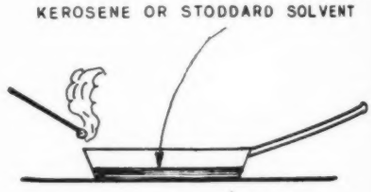


Fig. 2

dip the match directly in the kerosene the result is the same. Complete immersion of the match flame extinguishes it. If we substitute a lighter product such as Stoddard Solvent the results are the same. A match flame held directly above the liquid causes no burning; dipped quickly into the liquid, it is extinguished. The same with a burning card.

To carry this experiment further I shall moisten this calling card with a little of the liquid—just enough to form a thin film. If we hold a match to the card we find that it burns slowly; but again by dipping the card

[1]Substance of a paper delivered before Petroleum Section 26th National Safety Congress, Kansas City, Missouri, October 13, 1937.

[2]Fire Protection Engineer, Union Oil Company of California.

in the very liquid with which it is moistened, we can extinguish it.

Now we are beginning to learn something. When we held that match flame against the calling card, a tiny portion of the thin film of solvent was heated to the point where it gave off a vapor, and it was the vapor that burned. Because the solvent in the pan had not been heated it did not give off vapor so there was nothing to burn. We know now that *solids or liquids do not burn, it is only their vapors that do so.* If we heat all this solvent on a stove then it all will be at a temperature that will produce vapor. Let us try it. I place it on this stove. It will not take very long for it needs to be heated only to the temperature of the water you use for shaving—105 deg. to 110 deg. fahrenheit. A match flame

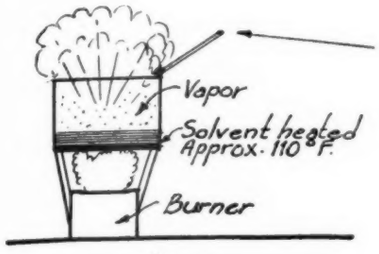


Fig. 3

held at the edge of the stove after the solvent has been heated will ignite vapors (Fig. 3). Note: take pan off stove before attempting to ignite vapors with match flame.

Not all oils require heating above room temperature. Some oils will give off vapor at the temperature of the surrounding air. This may be as low as 40 deg. fahrenheit. Included in these are gasoline, naphtha, benzine, alcohol, paints, and numerous other household articles. If we pour gasoline into a pan and hold a match flame above it (as in Fig. 2) the vapors will immediately burst into flame. So let us go back to that line we drew and revise it so that it looks like this:

FUEL (Vapor)

Further Proof

Here I have a jar of gasoline. On top of the jar is a sparking device connected to a battery. With it we can produce the same sort of spark we get in the motors of our automobiles. Notice that when a spark is produced beneath the liquid level (Fig. 4), there is no burning. Here we have a positive proof that the liquid does not burn. But, we say the vapors do burn so let us move the spark up into the vapor space. Again we see (Fig. 5) there is

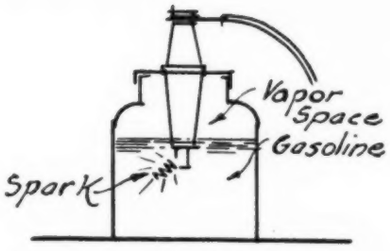


Fig. 4

no burning. That may be surprising. Let us try something else.

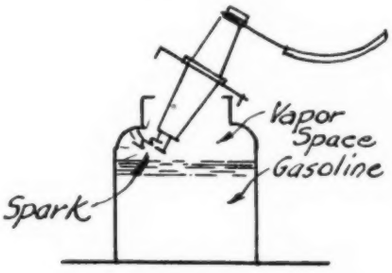


Fig. 5

This time we move the spark to a point just above the mouth of the jar (Fig. 6) and there burning occurs

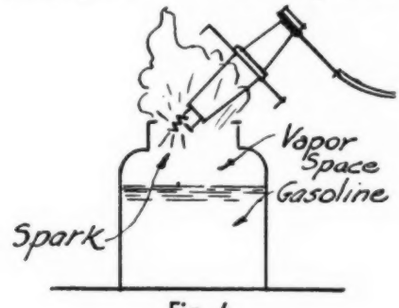
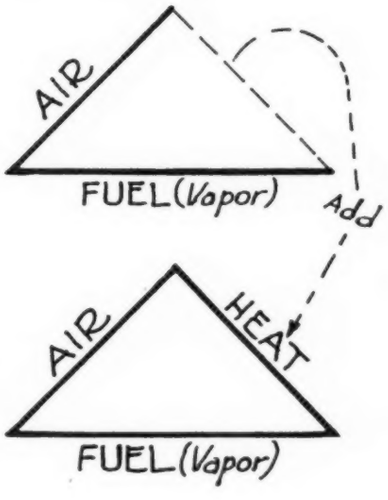


Fig. 6

because that is the only point where the vapors inside the jar have an opportunity to combine with air. So we establish another fact: *Unless there is air present, there will be no burning.*

Now we go back to that line and make it look like this:



What else do we need to build a fire? Here in this pan of gasoline (Fig. 7) we have fuel (vapor) above the

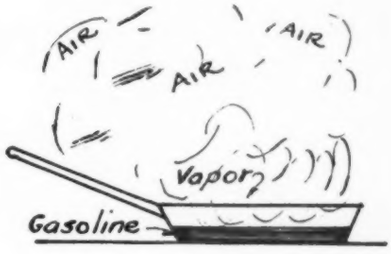


Fig. 7

gasoline and air all around that vapor —and yet we have no fire and won't have until we add one more thing—heat. When this is done our "fire" looks like the triangle. Whenever we put that triangle together we have a fire whether we want it or not. That combination will cause it regardless of what other condition may exist; whether it be hot or cold, wet or dry, makes no difference; also, the fire will be the same whether the fuel was gasoline vapor, wood vapor, coal vapor, or vapor from any other combustible substance. This is good to remember—to save for the time when that fire is to be controlled.

The fires that we have seen here were relatively small yet they came into being and behaved in exactly the same way they would have had they been larger. The gasoline vapors, in the small pan, combined with air and ignited from the match flame in the identical way that vapors from a large body of gasoline would take fire.

The behavior of the spark in the jar of gasoline, below the liquid, above the liquid, and in the mouth of the jar is no different from what would happen in a tank truck under similar circumstances. Compare Fig. 8 with

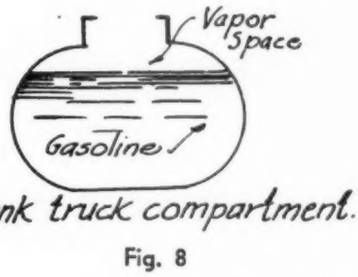


Fig. 8

Figs. 4, 5, and 6 and this is easily understood. Notice that the physical conditions are identical. This would be true of any other container, such as a delivery bucket, a drum or fuel tank. Fire exists solely because of an immutable natural law. There is no way in which we can create it in another manner. For example, just the fact

that we are afraid a fire will occur does not cause it to occur.

Explosions

Now that we have gone through the problem of ordinary fires let us take up another and more popular phase of our subject—explosions. In using the term "popular" I am thinking of the newspapers and the public more than you and me. Certainly the term is not popular with the oil industry. With the average newspaper reporter no gasoline fire can occur unless it originates as or terminates in an explosion. The story of an open tub of gasoline burning quietly in the middle of the street lacks the spectacular and therefore has a relatively low news value, but if it can be said that the gasoline "exploded" and thus endangered the lives and property of everyone within blocks of the site, it becomes "front page" news. This is especially true if the item is supplemented by a picture showing great clouds of billowing black smoke just as if the color or quantity of smoke given off by a burning substance is an indication of the severity of the fire. In naval operations, great smoke screens are laid down by airplanes and ships without fire at all. A gallon of carbon tetrachloride, an incombustible liquid, when heated, will give off more black smoke than a drum of burning gasoline. Incidentally, the "smoke" from the carbon tetrachloride will be a real hazard and not merely the product of some reporter's usually fertile imagination.

Storage Tank Explosions

A type of explosion about which there is great concern is storage tank explosions. There is no instance in the history of oil storage plants on the Pacific Coast where an explosion has occurred in a tank because of a spark or flame entering the tank. There have been two instances where tanks have ruptured from internal pressure generated by heat from flames outside the tank. In both of these instances, which occurred several years ago, the failure of the tank was caused by inadequate venting—a fault that long since has been corrected.

The storage hazard in a bulk oil plant should not be confused with the greater hazard of tanks in a refinery or other processing plant. In the latter facilities a great deal of experimental work is carried on because of necessity. The development of the automobile has come along, hand in hand, with petroleum refining technique. The car manufacturer cannot build a better car unless the oil industry can make a suitable product with which to operate it. Because of this experimental work and its accompanying handling of what are sometimes unfamiliar products whose characteristics are not definitely known, as they are known in the finished products handled in bulk plants, explosions may occur. Whenever they do, here is an illustration of what usually happens. This tube represents the tank (Fig. 9).

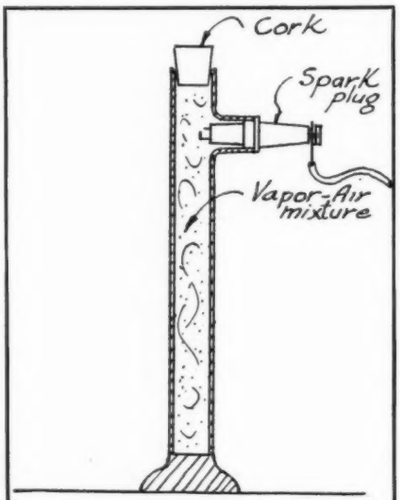


Fig. 9

I shall drop a few drops of gasoline into it and insert the cork in the top. Anchored at the bottom of the tube I have a piece of small chain. This chain serves to break up the drops of gasoline, causing them to vaporize, and the resultant vapor combines with the air already present in the tube. Now we fire the spark plug and we see that the cork is blown from the tube. We have had an explosion—the same sort of explosion that takes place in a tank. In this explosion the cork was blown out. In the case of a tank the roof would have blown off. There would not be and never has been a rupture of the shell in a conventional vertical storage tank. After the roof is gone the tank stands until all its contents are burned out. Even a tomato can filled with gasoline will burn itself out without melting its soldered seams. Try it sometime—you will find that to be true.

Let us try again. This time instead of putting in seven or eight drops let us try 20 drops. We repeat the shaking process. Now we fire the plug and to our surprise, nothing happens; why? because this time the tube is filled with a mixture too rich to burn, the same sort of mixture that was in the glass jar and in the underground tank; a mixture containing too much gasoline vapor and not enough air. We can prove that by inverting the tube and pouring out some of the vapor. It will pour because it is heavier than air. Notice that no liquid comes out.

Now we have changed the mixture and we replace the cork. This time we get an explosion. We learn from this that we not only need a combination of air and vapor to get a burnable mixture, we need an almost exact proportion of both. In every 100 cu. ft. of mixture, if we have more than six cu. ft. of vapor it will be too rich to burn. This fact will explain almost entirely why explosions never occur in bulk plant tanks. Such a tank in service will probably never have an explosive mixture in its vapor space. So much for explosions.

Conclusion

We have learned much in the analysis we have made. We know a great deal more of the actual hazards. Perhaps we can sum it all up in one simple test. We have learned:

1. That the fuel for every fire must be in vapor form.
2. Gasoline will give off that vapor without heating.
3. These vapors are heavier than air and accordingly will seek a level as water does, and
4. exposed to the surrounding atmosphere will combine with air to form a mixture that will burn when
5. it comes in contact with heat.

Now let us demonstrate all these. We take a ball of cotton (Fig. 10)

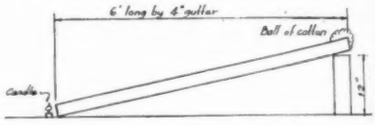


Fig. 10

and place it in the upper end of a trough. At the lower end of the trough we place a lighted candle. We moisten the ball of cotton with gasoline. Vapor flows down the trough, combines with air and finally reaches the candle flame. There is a slight puff, flame travels back up the trough, and the cotton bursts into flame.

Prevention

We are familiar with two types of fires in an oil plant. The first and the desired type, is of course the friendly fire that may exist under a boiler or be a part of the necessary operating requirements of the plant. The second, and undesirable type, is the unfriendly fire that may occur in a tank truck, at a loading rack or in a pump house. Naturally, our first thought should be to encourage the friendly fire and discourage the unfriendly fire. The most effective means of discouraging a fire is to prevent it altogether. After ob-

serving the triangle the measures necessary for prevention will be suggested to us. In other words, we may have fuel (in vapor form), plus air, without heat; or we may have air, plus heat, without vapor; or we may have vapor, plus heat, without air—and still be on the safe side. We may have any two we like anytime we like but never all three at the same time. The exclusion of air is a practical impossibility, but it is not extremely difficult in our operations to prevent vapor or heat. Whenever in our operations it becomes necessary to produce vapor, for example, by exposing gasoline to atmosphere because of drawing it off in a bucket or for any other reason, the obvious thing to do would be to ask ourselves first if we are producing the vapor in the presence of heat. The reverse would be true whenever we were committing an act that produced heat. By that I mean striking a match, throwing an open switch, striking a heavy blow with a hammer or some other metallic object, or doing any of those things that produce heat. Before doing so we should always ask ourselves the question, "Am I doing this in the presence of vapor?" These are simple illustrations but I am sure they convey the general idea.

Occasionally prevention fails. Prevention fails because men fail. Either the man who designed the equipment, or the man who operates the equipment, or the man who maintains the equipment has failed. With failure, comes fire.

Control

Once a fire is under way the thing we need most is control of that fire—control of the three things that go to make up the fire, that is, vapor, air, and heat. In starting out to control a fire we first devote our efforts toward control of the thing that is most important to its existence, that is its fuel (vapor). Inasmuch as vapor is a product of the liquid, obviously this becomes a matter of control of the liquid in most cases; shut down of pipelines and systems that contain liquid. On the other hand, there are times when vapor itself can be controlled.

We have said that it was not possible to exclude air but once the fire is underway the control of air is sometimes relatively simple. For example, if we had a fire burning in a tub of gasoline and the tub was only partially filled, we might direct a stream from a foam extinguisher into the burning gasoline. This would result in very little effect insofar as extinguishing the fire was concerned for the force of the stream as it struck the surface of the liquid would naturally splash the liquid and expose more of it to atmosphere, thus creating more vapor and intensifying the fire; also the foam would be submerged beneath the liquid and become coated with oil that in itself would burn and break down the foam as it returned to the surface because of its buoyancy. If, however, we were to direct our foam stream against the side of the tub, foam would then build up and of its own weight slide across the surface of the liquid and give us something that would be a substitute for a blanket. Of course, if at the beginning we had placed a wool blanket over the tub, the fire would have been extinguished because in this way we would have controlled the air, controlled the amount of air being permitted to combine with the vapor, thus creating a deficiency of air to support combustion. Air may be controlled in other ways through the use of gases such as are produced by vaporizing carbon tetrachloride fluid from the small pump type extinguisher or the gases delivered from a CO_2 extinguisher. Both of these gases are much heavier than air and displace it in the burning area and, being inert, suffocate the fire.

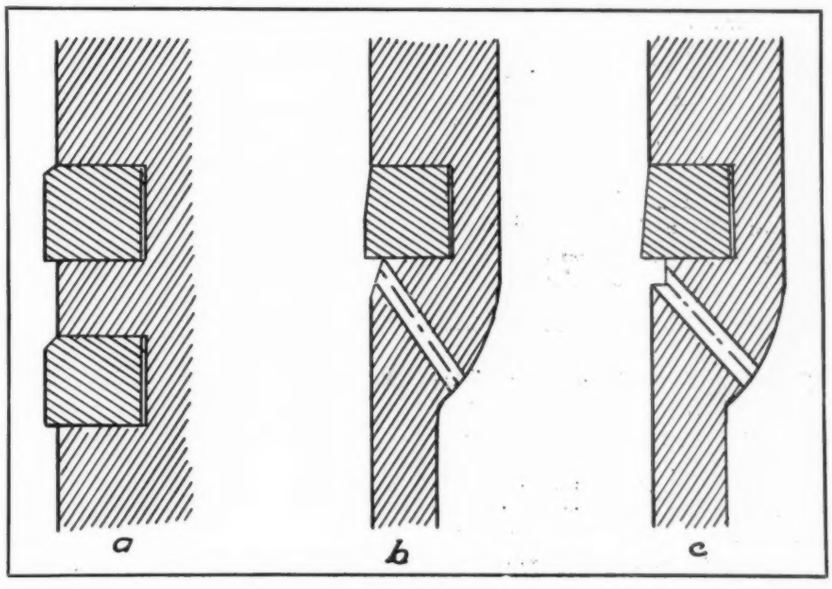
In dealing with the matter of fire control I have very hurriedly skimmed over the possibilities. For the sake of convenience I have dealt only with those fires that require the use of first-aid fire appliances for extinguishment. Naturally it is always possible that the fire may become too big for the extinguisher you may have at hand and other means must be taken. In any event, however, regardless of the size of the fire or the amount involved, the principles of extinguishment will be identical in every respect.

Prevention of "Oil-Pumping"

By J. L. INGRAM

"OIL-PUMPING" in the internal combustion engine is not always caused by worn rings and liners. Piston rings of many designs are available, and much is claimed for some of them; however, it is well for the engineer to have some idea himself of what he desires.

Some manufacturers prevent oil-pumping by rounding off the upper corners of the piston rings as shown in (a), in the accompanying drawing. The last ring usually is made as a scraper ring with a slight bevel as shown in (b). Drilling a small hole toward the inside of the piston and beveling off the lower groove assists in the removal of excess oil. The more effective scraper ring with an undercut, shown in (c) may be used in case of excessive consumption of lubricating oil. The objectionable feature of rings exerting a high specific pressure, although their action is similar to that of a scraper ring, is the increased ring and liner wear.



Making an electric weld during construction of Utilities Pipe Line Corporation's gas line

By
NORMAN X. LYON

Interest aroused when acute shortage of gas in Mt. Pleasant and Clare was relieved by dramatic completion of line as pressure at city gates declined to eight pounds

Laying of Short Michigan Gas Line Attracts Wide Attention

ALTHOUGH approximately 800 miles of pipe line has been constructed in Michigan since 1929, it remained for a 14-mile, 4-in. gas line laid in November of this year to focus interest of the general public on pipe line construction. The line, constructed by the H. L. Gentry Engineering Company, Jackson, Michigan, for the Utilities Pipe Line Corporation, was little more than a routine construction job; however, before it was completed the Michigan press was giving it front-page prominence, and thousands of readers were discussing it who never had heard of many bigger and more important construction projects.

The line was built in a last effort to avert an acute shortage of natural gas in Mt. Pleasant and Clare. It was completed with a dramatic finish at midnight November 29, as pressure on gas from old fields fell from a normal pressure of 75 lb. to 8 lb. at the city gates.

The 1936 consumption seriously depleted reserves in the Clare and Vernon fields, the two sources of supply for the Gas Corporation of Michigan, subsidiary of Great Lakes Utilities. A survey was launched early this year in an attempt to open new gas fields and to make contracts for additional reserves. The Gas Corporation of Michigan serves Mt. Pleasant and Clare. The two towns, having a combined population of 12,000, were the first to take natural gas from Michigan fields and approximately 70 percent of the houses, including schools and public buildings, are supplied with gas for heating; therefore a "gas shortage" was important news for metropolitan daily papers.

After surveying reserves in the Arenac (Berea sand) field, 80 miles northeast of Mt. Pleasant, and casinghead gas reserves in both the Buckeye and Sherman oil fields, the Gas Corporation of Michigan decided that the most feasible and economical program was to lay a line into the Sherman field 14 miles west of Mt. Pleasant.

Approximately 3,000,000 cu. ft. of casinghead gas was available in the Sherman field, and a contract was closed with the Consumers Power Company to "borrow" up to 100,000,000 cu. ft. of dry gas at their Two Rivers compressor station, near the terminal of the proposed 14-mile line.

Drilling-in a 1444-ft. Michigan Stray Sand gas well in Sherman township, Isabella County, which, although producing initially only 1,300,000 cu. ft., proved an important supply for the Gas Corporation of Michigan. The well was completed the day after the 14-mile pipe line was tied-in

Consumers Power Company has under contract most of the Broomfield-Sherman and Six Lakes gas fields. The borrowing contract specifies a maximum of 800,000 cu. ft. of gas daily and expiration of the loan on April 15, 1938.

Construction began on the 14-mile line November 2, but delay in pipe deliveries retarded construction so that on November 28 three miles of pipe at the Mt. Pleasant end of the line still was unstrung. The last cars of pipe were sidetracked 18 miles away and the pipe was trucked in as the temperature dropped suddenly to 15 deg. above zero.

The first 11 miles of the line was electric welded but because gas engineers estimated that unless the line was tied in by Tuesday morning, November 30, the two old fields would be incapable of supplying more than 40 percent of the required peak load, approximately 2,000,000 cu. ft. per 24 hours, the last mile was Dresser-coupled simultaneously as welders stove-piped the other two miles. On Monday morning, November 29, one and one-half miles remained unfinished, and city gas pressure declined to eight pounds. Burners in outlying areas went out and industrial users were restricted to limited service.

Pipe line crews worked through the Monday night dinner hour and at 11 p. m. made the last weld. An hour later gas from Consumers Power Company was cut into the system and the two towns were "saved."

The following day, December 1, the picture was further brightened when the development subsidiary of the Gas Corporation of Michigan completed a 1,300,000-cu. ft. well in the Michigan sand at a depth of 1444 feet, a half mile from the Sherman terminal of the new line, indicating a possible new reserve and providing a much-needed immediate supply of gas.

The Gas Corporation of Michigan has closed contracts with the Pure Oil Company and the O. H. Grimes Company to purchase processed casinghead gas in the Sherman oil field. Pure Oil Company controls 90 percent of the proven oil reserves in the Sherman field. The Grimes company operates casinghead gasoline plants in the Greendale and Yost-Jasper oil fields, also controlled by Pure Oil Company, and plans immediate construction of a sulphur extraction plant in the Sherman field. It probably will not be placed in service until March.

The Gas Corporation's plan to use stripped casinghead gas in Mt. Pleasant and Clare to bolster depleted reserves from dry-gas sands is a new program in Michigan. It will mark the first domestic utilization of oil-field gas. In the Greendale, Yost-Jasper, and Porter fields of Midland County residue gas from gasoline plants is used in Pure Oil Company's repressuring operations. No use has been made of casinghead gas in other major fields such as Buckeye, Clayton, Crystal, Ogemaw, and Allegan, except as fuel for drilling wells and for field camp requirements.

H. L. Gentry (left) in charge of laying the line, and (right) O. L. Salyer, construction superintendent, watching last tie-in on gas line

Fifth Edition of "Petroleum Facts and Figures" Published

PUBLICATION of "Petroleum Facts and Figures," Fifth Edition, 1937, has been announced by the American Petroleum Institute. This edition is the first to be published by the A.P.I. since 1931.

Effort has been made to incorporate in the new edition all available data regarding the industry, so that the volume will be complete and comprehensive. The format has been changed to eliminate most of the text and to permit the inclusion of additional statistical data and illustrations. For the first time the volume presents pictorial graphs and charts.

Subject matter is divided into eight sections. The first, concerning utilization, shows various uses of petroleum and its products and presents consumption figures by years.

The second chapter, covering production, shows the output of crude oil by continents, nations, states, and fields since production records first were kept. Allied subjects, such as petroleum reserves, deep drilling records, crude oil prices, and production of other products also are presented.

Transformation of raw materials into usable products is considered in the third chapter, which deals with refining. The figures reveal the remarkable progress made in the refining branch of the industry, new processes producing twice as much gasoline from a given quantity of crude oil, improving quality, and reducing prices.

An insert presents one of the first complete lists of principal petroleum products to be compiled in recent years.

Transportation of petroleum and its products to millions of consuming agencies is covered in the fourth chapter.

Markets and prices are covered in the statistics of the fifth section, which presents a complete record of gasoline prices and taxes in 50 cities.

Opposite trends are shown in the sixth section, in which comprehensive data on taxation disclose how heavily the petroleum industry and its customers are levied upon for the support of government.

The seventh, or general, section presents facts and figures on the industry's capital investment, pay rolls, earnings, etc.

The eighth section, comprising an appendix, presents condensed tables covering a long period of petroleum exports, imports, consumption, production, refining operations, etc. Also presented are lists showing A.P.I. officers, board of directors, and standing and special committees; lists of petroleum and allied trade associations, both national and state; a complete list of Institute technical and other publications; and an index.

The volume contains all the pertinent statistical information presented in the first four editions of "Petroleum Facts and Figures," with all data modernized. Copies are priced at 75c per single volume, with discounts for quantity.

Procedure For Hard-Facing Steel

RECENT researches and developments have brought out certain points in connection with the actual technique that make it desirable to present a detailed procedure for hard-facing steel. The information should prove of value to welding operators.

To illustarte in its simplest form and yet most detailed manner the procedure for hard-facing steel by the oxy-acetylene process, the application of Haynes Stellite to a small strip of steel will be described. The steel sample is approximately 1¼ in. wide, ⅜ in. thick, and 8 in. long. Although this simple piece was selected to illustrate the various operations, the instructions apply generally to most types of parts to be hard-faced.
welding practice plus careful observance of the special instructions and precautions given here, is all that is necessary to produce an excellent hard-facing job.

Preparation of the Part

Step No. 1—Thoroughly clean the surface of the steel part to be hard-faced by grinding or machining until it is free from all dirt, scale, grease, or other foreign material. Round off all sharp corners. If a hard-faced edge or corner is to be subjected to shock, as on a punch, a shear blade or a die, the steel should first be machined as shown in Fig. 1 (left). The support thus given the hard-facing alloy will enable it to withstand a shock applied vertically, or parallel to the thicker dimension of the alloy deposit. The ratio of widths should be as shown: i.e., 2 or 3 to 1.

If no severe impact is to be encountered, angles or corners to be hard-faced should be machined as in Fig. 2 (center,) which shows the method of shaping a steel exhaust valve seat insert ring prior to the application. If the wear-resistant alloy is to be applied to a longitudinal area as on a rolling mill guide, the parts should be grooved with radii of the same length as the depth of the groove, as shown in Fig. 1 (right).

If it is impossible to grind or machine the part, it can be filed. In any case, the steel surface on which the hard-facing alloy is to be deposited must be clean.

Preheating

Step No. 2—For medium size parts heat with a neutral welding flame to about 800 deg. fahrenheit. This is a very faint red heat, visible only without goggles in a darkened room. For large parts preheat in a furnace; for small parts preheat with the welding flame. It is economical to preheat in a furnace when such equipment is available, unless the part can be preheated quickly and thoroughly with the blowpipe flame. Do not, however, preheat to a temperature higher than the critical temperature of the steel to be hard-faced, or to such a high temperature that will cause the metal to scale.

Flame Adjustment

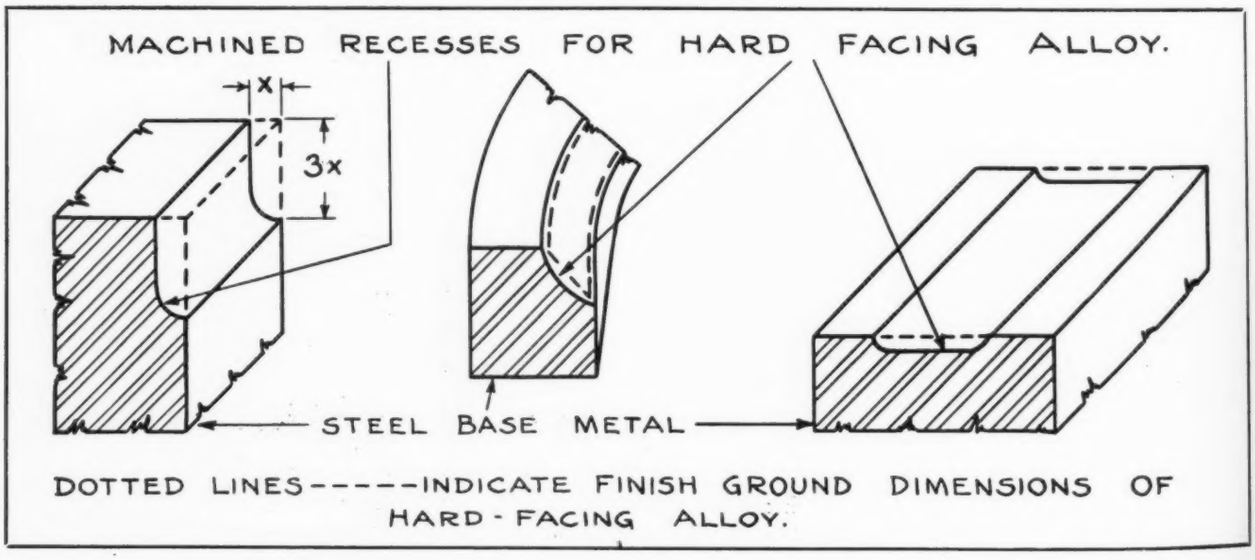
Step No. 3—Adjust the flame so that it has an excess of acetylene. The total length of the excess acetylene feather should be about three times as long as the inner cone measured from the end of the welding tip, as shown in Fig. 3.

This flame should be used for all steel operations with Haynes Stellite. The excess acetylene flame prepares the steel surface by causing an extremely thin surface layer to melt, giving the steel the watery, glazed appearance known as "sweating." Production of such a "sweating" condition is necessary for the successful application of this hard-facing alloy to steel, and it can be produced only by an excess acetylene flame as shown. Furthermore, unless an excess acetylene flame is used, the alloy will not spread uniformly and will become porous.

Producing "Sweating"

Step No. 4—Hold the blowpipe so that the excess acetylene flame is directed at an angle of from 30 to 60 deg. to the steel surface. The tip of the inner cone should be about ⅛ in. from the steel. Keep the blowpipe in this position until the steel under the flame suddenly becomes glazed, indicating that an extremely thin surface layer has melted. This is the condition known as "sweating." The extent of the "sweating" area will vary according to the size of the welding tip, but

Fig. 1. Sectional view showing method of machining steel edges and corners preparatory to hard-facing when the part is to be subjected to shock or impact



for a medium size tip, the steel should "sweat" for a distance extending about ¼ in. around the excess acetylene feather. The steel part is now ready for the application of hard-facing alloy. (See Fig. 4.)

Beginning the Application

Step No. 5—Withdraw the flame just enough so that the end of the welding rod can be brought between the inner cone of the flame and the hot steel. The tip of the inner cone should just about touch the rod and the rod should lightly touch the "sweating" area. The end of the rod will then melt and form a puddle on the "sweating" steel surface. If the first few drops foam or bubble, or do not spread uniformly, the steel is too cold, and should again be brought to the full "sweating" temperature described in steps No. 3 and No. 4.

Continuing the Deposit

Step No. 6—Spread the molten alloy over the "sweating" area by removing the rod from the flame and directing the flame into the puddle. Return the rod to the flame and melt off more alloy into the puddle, as required.

Now direct the flame so that part of it plays only on the edge of the puddle to keep it molten and part of it plays on the steel surface adjoining the puddle. As the steel reaches the "sweating" heat, the puddle of hard-facing alloy will spread over the "sweating" area. As it spreads, bring the rod quickly into the flame again, and with the end of the rod touching the puddle, melt more alloy into the spreading puddle. Continue these steps steadily until the desired area is coated. (See Fig. 5 (bottom) and Fig. 6.)

With a little practice, the correct amount of hard-facing alloy can be added to make the deposit the desired thickness, and it is better to do this in one operation than to go back over the whole job to add another layer of alloy. During the operation, the flame can be moved back repeatedly to melt just a thin surface layer of the deposited alloy in order to smooth out high spots just behind the molten puddle. This should be done quickly without allowing the front edge of the puddle to solidify and without interrupting the steady forward progress of the work. If desired a second pass can be made with the flame to smooth off the surface and to minimize grinding.

The puddle should be flowed in the direction desired by means of the pressure of the flame, not by stirring with the rod. Usually the work progresses toward the hand holding the rod, but on steel that scales badly, or on very thin sections, the backhand method (illustrated in Fig. 7) is sometimes used. With this method, the work progresses toward the hand holding the blowpipe. The welding operator can determine with practice the preferable method for any particular job.

If any dirt or scale appears on the steel or in the puddle, float it to the surface with the flame. If it will not float, dislodge it with the rod. In extreme cases, it may be necessary to use a good cast-iron welding flux.

Cooling the Deposit

Step No. 7—When the deposit has been built up to the desired size and thickness, remove the flame slowly from the puddle to prevent the formation of shrinkage cracks or blowholes. If these are present, remelt the deposit in their immediate vicinity, flick any particles of scale or oxide from the pool with the rod and add a little more hard-facing alloy from the welding rod. If the holes still appear, it may be necessary to grind off the alloy deposit down to the steel at that point, warm the area gradually with the flame and deposit additional hard-facing alloy there. As soon as the deposit has cooled below a red heat, it is often advisable to place the entire part in a box of powdered mica, lime, ashes, or other similar heat-insulating material so that it will cool slowly.

In many cases, slow cooling is absolutely essential to produce a deposit free from cracks and internal stresses. Parts that show a strong tendency to crack, such as large gate-valve wedges and seat rings, pump-shaft sleeves, or parts on which the deposit is circular or large in area, preferably should be placed in a heat-treating furnace while still hot from welding, brought slowly to a low red heat (about 1150 deg. fahr.), and then allowed to cool overnight in the furnace with the door closed and the heat turned off. Never cool a part by dipping it in water.

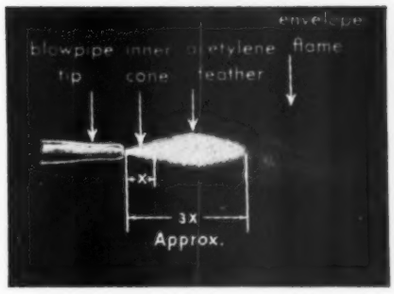


Fig. 3. Excess acetylene flame used for all hard-facing operations. An excess acetylene flame is used to produce "sweating" before the hard-facing alloy is applied

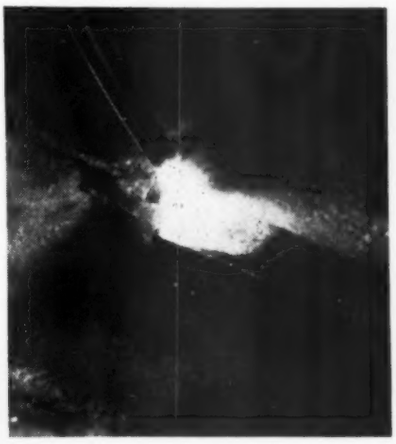


Fig. 4. After preheating, and with excess acetylene flame adjusted, "sweating" is started with blowpipe tip and flame in this general position

Fig. 2. Hard-facing a high-pressure, high-temperature steam regulating valve disk

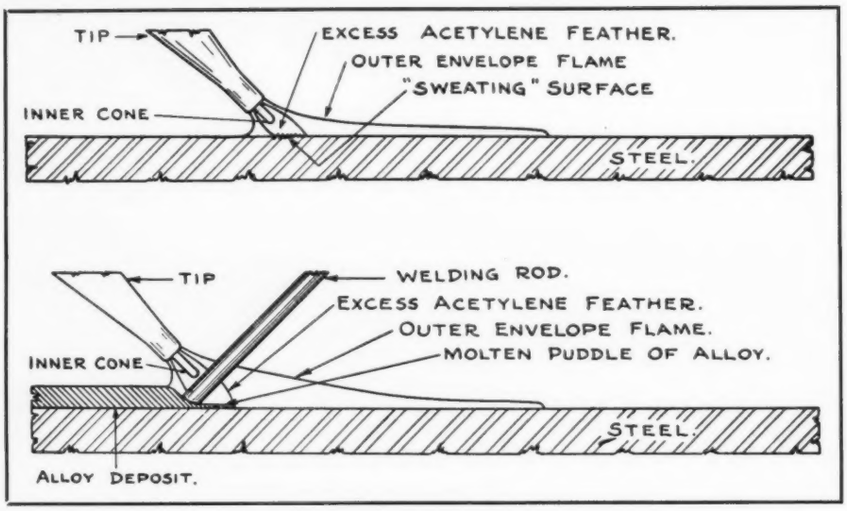


Fig. 5 (top). Conditions of flame position and regulation to produce "sweating." (bottom) — Approximate relationship of tip, rod, puddle, and base metal during hard-facing

Finishing the Deposit

Step No. 8—After the hard-faced part has cooled, it may be necessary to remove the high spots or grind the hard-faced surface to an exact size. This is done by hand, or on a grinding machine. Any soft grade vitrified wheel, not coarser than 46 or finer than 60 in Grade I or J, is suitable for grinding. The wheel speed should not be less than 3000 nor more than 4500 surface ft. per minute. Higher speeds are liable to check the work.

Welding Tip Size

The best blowpipe tip size to use for average work is one having a consumption of approximately 20 cu. ft. of oxygen per hr. and 23 cu. ft. of acetylene per hour. For small parts, a tip one size smaller should be used; and for large, heavy parts, a size larger. The welding operator will be able to judge the proper tip size for each job very easily after he has hard-faced a few parts. It is better, however, to use a tip that allows slow, careful deposition without overheating the steel than to use a large tip and try for too much speed.

Drawing Out Rod

In some cases, especially when applying the cobalt-chromium-tungsten hard-facing alloys to small areas or parts, it is best to use a welding rod of ⅛- or 3/16-in. diameter. If the smaller diameter rods are not available, ⅜-in. or 5/16-in. rod can be "drawn out" to the smaller size. To do this, melt one end of the rod with the usual graphite, iron, or steel. With the flame playing on the end of the rod and melting it, and the end of the rod touching the plate, draw the rod along excess acetylene flame, and lay the first drop on a cold plate of carbon, the plate at a steady rate, leaving a newly-formed rod of smaller diameter ready for use.

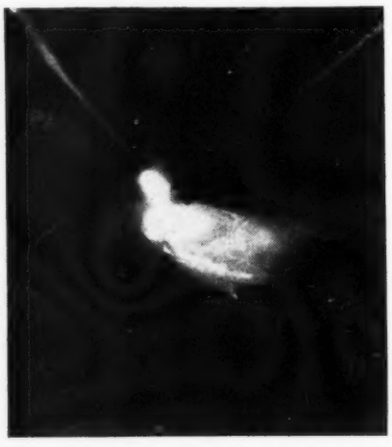


Fig. 6. The deposit should be built up to the desired thickness in one operation

Grades of Hard-Facing Alloy

There are three grades of the cobalt-chromium-tungsten hard-facing alloy, Haynes Stellite. The three grades are known as No. 1, No. 12, and No. 6. This is the order of their hardness and resistance to wear.

Grade No. 1 is the hardest of the three grades and is more resistant to abrasion than grades No. 12 and No. 6. Its hardness when welded is C-54 Rockwell; its tensile strength is 54,000 lb. per sq. in.; elongation nil. Extreme pressure or heavy shocks are liable to check or chip it, but when it is properly backed up and supported, no trouble will be experienced with it. This grade should be used for coating surfaces subjected to extreme abrasive wear and only little shock or impact.

Grade No. 12 is not quite so hard as grade No. 1 and is slightly less resistant to abrasion. It is, however, much stronger and somewhat more ductile and, therefore, should be used for coating fairly large areas where hair-line cracks would interfere with efficient operation. It will withstand more shock and impact than grade No. 1. This grade has a hardness when welded of C-48 Rockwell and a tensile strength of 99,000 lb. per sq. inch.

Grade No. 6 is not quite so hard, but is considerably tougher and stronger than grades No. 12 and No. 1. Though it is tougher than grades No. 12 and No. 1, its resistance to abrasive wear is slightly lower. It does not check or chip easily and is recommended for coating surfaces subjected to shock or impact and wherever a keen cutting edge is necessary such as hot shearing and blanking dies and valve-seating surfaces of all kinds. Its hardness when welded is C-40 Rockwell; its tensile strength is 110,000 lb. per sq. inch.

The selection of a suitable base metal is important. Although plain carbon steel is excellent for many purposes, for parts subjected to shock and impact, such as hot and cold trimming dies, SAE 3140 steel has proved to be a particularly ideal base material. This steel will not mushroom under impact, as it can be given its standard heat-treatment after hard-facing.

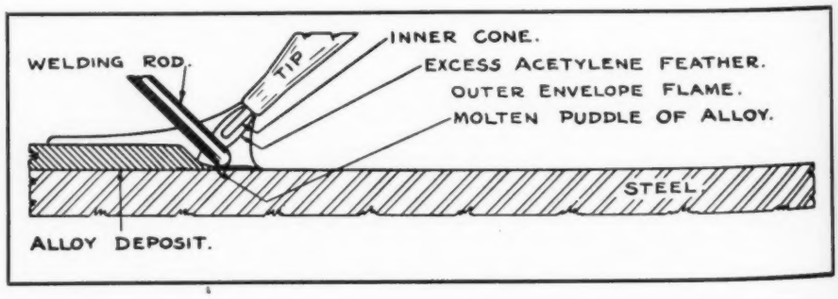
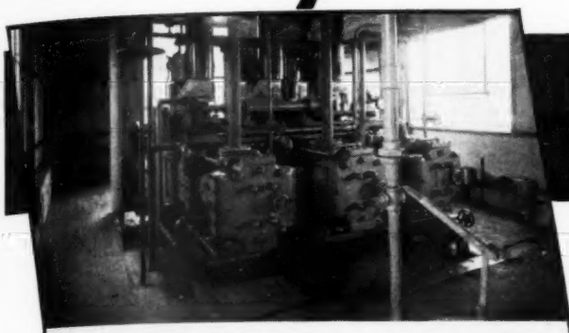


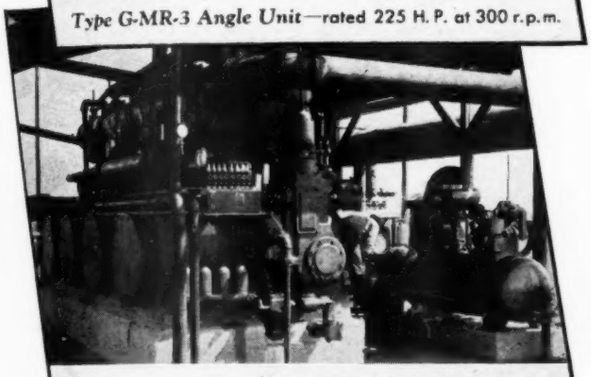
Fig. 7. The backhand method of hard-facing. The approximate relationship of tip, rod, deposit, puddle, and base metal during hard-facing by this method is shown

Compact? Sure!

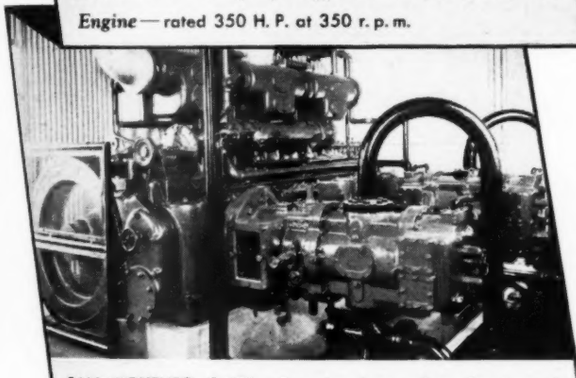
BUT THAT'S NOT ALL..



CLARENDON, PA.—Compressing propane for refrigeration in Penn-Kansas Petroleum Company's lube-oil de-waxing process. *Type G-MR-3 Angle Unit*—rated 225 H. P. at 300 r.p.m.



FENTON, LA.—Driving centrifugal oil pipe-line pump for Continental Oil Company. *Type G-MR-4 Vertical Gas Engine*—rated 350 H. P. at 350 r. p. m.



SAN MIGUELITO, CALIF.—Pumping dry gas from Continental Oil Company's Hobson lease into Industrial Fuel Supply Company's main line. *Type G-MR-3 Angle Unit*—rated 225 H. P. at 300 r. p. m.

• • • The primary purpose of the Cooper-Bessemer Type G-MR is to provide more horsepower in less space. But, in the design of these engines and compressor units, we have been careful to insure ***low operating and maintenance costs,*** and ***long life.***

We invite you to go over the Type G-MR design, point by point, and ***compare*** its reliability and economy with any other two-cycle unit in the power range of 150 to 300 H. P.

You'll find the G-MR "better engineered!"

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Type G-MR

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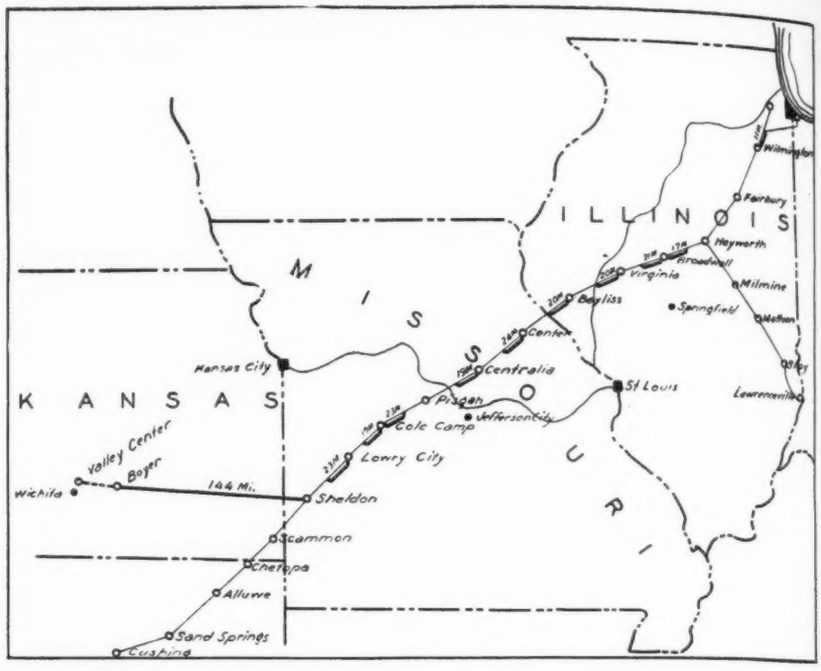
Map showing route of The Texas-Empire's line, location of loops, and pumping stations



Two-Year Expansion Program Completed on The Texas-Empire Line

Looping of line and additional pumping units increase capacity

LAST month saw the completion of a two-year program by The Texas-Empire Pipe Line Company that has increased the capacity of their crude oil line between Oklahoma and points in Illinois from 72,000 bbl. daily to 90,000 barrels.

Early in 1936, after the original line built in 1929 and 1930 had been operating at capacity for some time, it was decided to loop all sections of the line between Sheldon, Missouri, and Mattoon, Illinois. The crude to supply this additional capacity was to come from the Western Kansas fields. A 10-in. line was laid from Valley Center, Kansas, to Sheldon, Missouri, to transport the crude to the main line. The main line loops totaled 197 miles of 12-in. pipe (the same size as the original line). By September of last year these loops, together with the Valley Center branch, were completed to give the 18,000-bbl. daily increase.

In maintaining this capacity, however, it was necessary to operate the stations at full capacity. This meant that the unit reserved as a standby pump was pressed into service. With all pumps on the line in operation any shut-down of a unit at one station meant a shut-down of a corresponding unit at all other stations. The next step in the expansion program was to enlarge the stations by providing the standby pump.

During the summer of 1937 Diesel-driven pumping units were added to six of the stations and motor-driven pumps to two others. These additions, together with the transferring of two other units and the laying of two more loops, completed the expansion program.

At the Sheldon junction a 600-hp., 17½ by 25, 5-cylinder McIntosh-Seymour engine connected to a 6½ by 24, 37,500-bbl. Prescott pump was installed. It was necessary to enlarge the station building for this unit, the only station on the line requiring a larger building. At the other five stations where Diesel units were added—Lowry City, Pisgah, and Center, Missouri, and Virginia and Wilmington, Illinois,—by rearranging the office and the auxiliary lighting unit enough space was provided for the new units. To these stations were added a 550-hp., 16¼ by 23, 5-cylinder Busch-Seltzer engine connected to a 6½ by 24, 30,000-bbl. Prescott pump, the latter having forged-steel heads. At Mattoon, Illinois, a 300-hp., 14 by 17, 4-cylinder Busch-Seltzer engine was installed to operate a 25,000-bbl. centrifugal Goulds pump through a Ferrel-Birmingham gear increaser.

At Fairbury, Illinois, and Eldorado, Kansas, (Valley Center Station) motor-driven pumps were installed. At the former a 100-hp. motor is being used to drive a 4½ by 12 Prescott pump and at the latter a 300-hp. motor drives a 6 by 24 Goulds plunger pump.

With the installation of the 30,000-bbl. pump at Wilmington two smaller units in this station were sent to the Heyworth and Fairbury stations. These transfers were made to effect a better balance on the line.

Construction and installation work on all stations was done by company employees under supervision of company engineers. As the work was accomplished during the season of the peak pumping load it was necessary to proceed without interfering with regular station operation.

Talco Refinery Designed Primarily for Producing Asphalt

Special type plant constructed to take full advantage of the properties of the crude processed, which is a heavy, viscous, asphalt-base oil high in sulphur content, capable of yielding a high-octane gasoline and other products as well as asphalt

By A. E. BURGES

THE new refinery of the Talco Asphalt and Refining Company at Mt. Pleasant, Texas, owned by Capt. J. F. Lucey, D. Harold Byrd, Ralph E. Fair, and Jack E. Frost, all of Dallas, has a crude throughput of approximately 7000 bbl. daily. The plant is situated on the Cotton Belt railroad just off U. S. Highway 67 one mile west of Mount Pleasant.

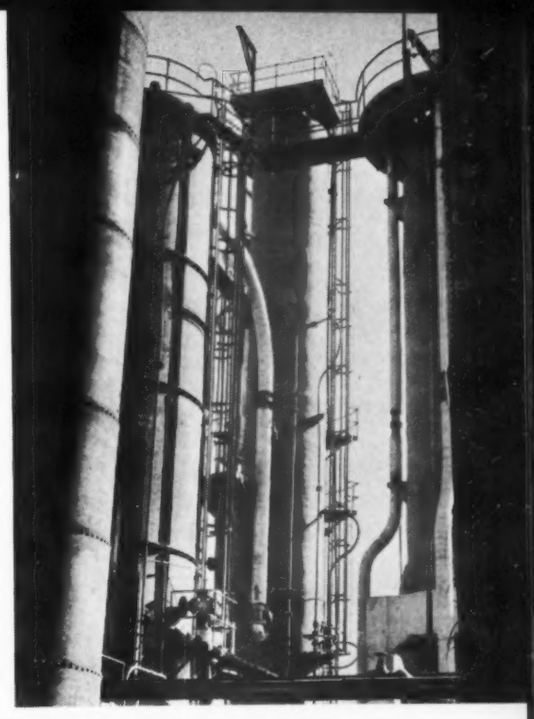
All buildings are of structural steel. As a further protection against fire, a 6-in. water main encircles the plant. Fire plugs are installed at strategic points. Pressure on this line is maintained by dual pumping facilities, which draw water from the artificial lake that serves as reserve water supply for the refinery. Every storage tank is equipped with a steam fire-smothering system.

Steel storage tanks having a total capacity of 350,000 bbl. are situated on the 80-acre tract. Tanks having a total capacity of 156,000 bbl. are devoted to the storage of asphaltic products, the remainder being used for the storage of crude, cracking stock, gasoline, etc. All asphalt piping and pumping facilities are steam-jacketed in order to maintain a temperature sufficient for rapid and economic transfer of this otherwise viscous product.

Crude from the Talco field differs from East Texas crude in that it is a heavy, viscous, asphalt-base oil high in sulphur content. Experimental work showed that the quality of the asphalt was excellent and that the overhead straight-run products would yield a quantity of high-octane gasoline. These and other facts clearly indicated that a refinery of a special type must be constructed to take advantage of the qualities of the crude. The Dubbs cracking process was decided upon because of its flexibility, and rights to the process were leased from the Universal Oil Products Company.

The crude oil arrives at the refinery through the line of the Talco Pipe Line Company, in which Capt. Lucey and associates are financially interested. Refinery crude storage consists of two 10,000-bbl. charging tanks and two 55,000-bbl. crude-reserve tanks. When needed, oil is pumped into the charging tanks, passing through a heat exchanger that is heated by vapors from the cracking unit. When the crude, heated to 250 deg. fahr., has settled in a settling tank the salt water and other easily-removed impurities are drawn off.

Crude fractionating column

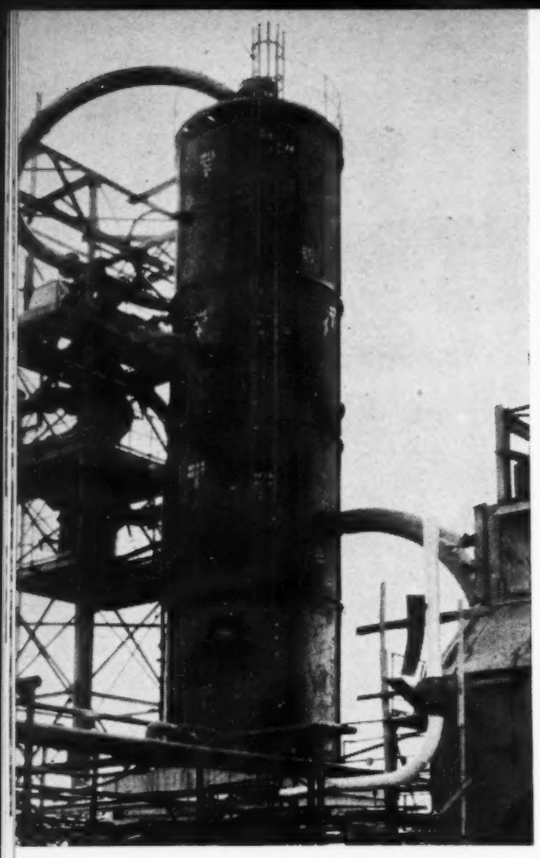


Cracking units of the Talco plant as seen between smokestacks of the heaters. Left to right: flash chamber, cracked fractionating column, reaction chamber

The crude is then pumped through a heat exchanger where its temperature is raised to 325 deg. fahrenheit. It then enters the top of the heater and passes through a convection section, thence across the hip tubes and down through one radiant section to the bottom and out to the crude fractionating column. The construction of the furnace in this heater is a feature of the refinery in that it is a double coil furnace, the convection section, the hip tubes, and one radiant section being used to heat the crude and the other radiant side being used for an asphalt heater. The dividing wall inside the heater is set off-center to give a greater distance between tubes and heating source on the asphalt side. This permits relatively low rates of heat transfer in the asphalt heating section and eliminates danger of localized overheating. Each side may be fired independently and the temperature controlled separately.

Straight-run gasoline vapors pass from the top of the crude fractionating column through a submerged coil-type condenser to the storage tanks. Naphtha, kerosene, and 30-36 deg. gas oil are taken off in side cuts and pumped to storage, passing through steam strippers enroute.

The topped crude (asphalt) enters a steam stripper from the bottom of the fractionating column and is pumped to the heater but to the radiant sec-



Vacuum column

tion opposite that used for heating the fresh crude. It passes down this radiant section and thence to the vacuum column.

Gas oil is taken from the top of the column and passed through a condenser to a distillate receiver. Part of it is pumped to storage and part is returned to the vacuum column as reflux. A side cut is also taken from the bottom bubble deck and pumped to storage. The asphalt passes over ring and doughnut pans to the bottom and is pumped to storage.

Within the vacuum column the pressure is 29.5 in. mercury, which is within one-half inch of absolute vacuum. Under this slight pressure high efficiency is obtained in the separation of asphalt using a minimum amount of heat. The vacuum is maintained by twin 3-stage steam ejectors. This is a feature of the Talco plant.

In the cracking section gas oil or topped crude is taken from storage and introduced into the absorption column where it meets gases from the distillate receiver at a controlled pressure and absorbs the more valuable heavy constituents from the gases.

Leaving the absorption column, the material being refined is pumped into the cracked fractionating column. Lime slurry is added to minimize corrosion. Cracked gasoline leaves the top of the column, passes through a heat exchanger, condensers, and a sub-cooler into a distillate receiver. The condensed portion of the gasoline is drawn from the bottom of the receiver and passed through another heat exchanger, a stabilizer, a reboiler, a cooler, and a caustic wash to storage. The non-condensable portion of the gasoline that leaves the top of the receiver is conveyed to the absorption column and recycles over its original route.

The cracked fractionating column is equipped to deliver side cuts of three grades of cracked naphtha, but at present the only cuts being taken are light and heavy oil cracking charges. The light oil passes to a light-oil heater, thence to a reaction chamber, and thence to the flash chamber. The cracked residuum from the bottom is passed to storage, while the more volatile portions are returned to the lower section of the cracked fractionating column. The heavy oil is pumped through a heavy oil furnace and then follows a corresponding route. When it is desired to reform straight-run gasoline or naphtha it is taken from storage, passed through a heat exchanger, a reforming heater, and into the flash chamber, and over the same route to storage as the cracked products of the light and heavy oils.

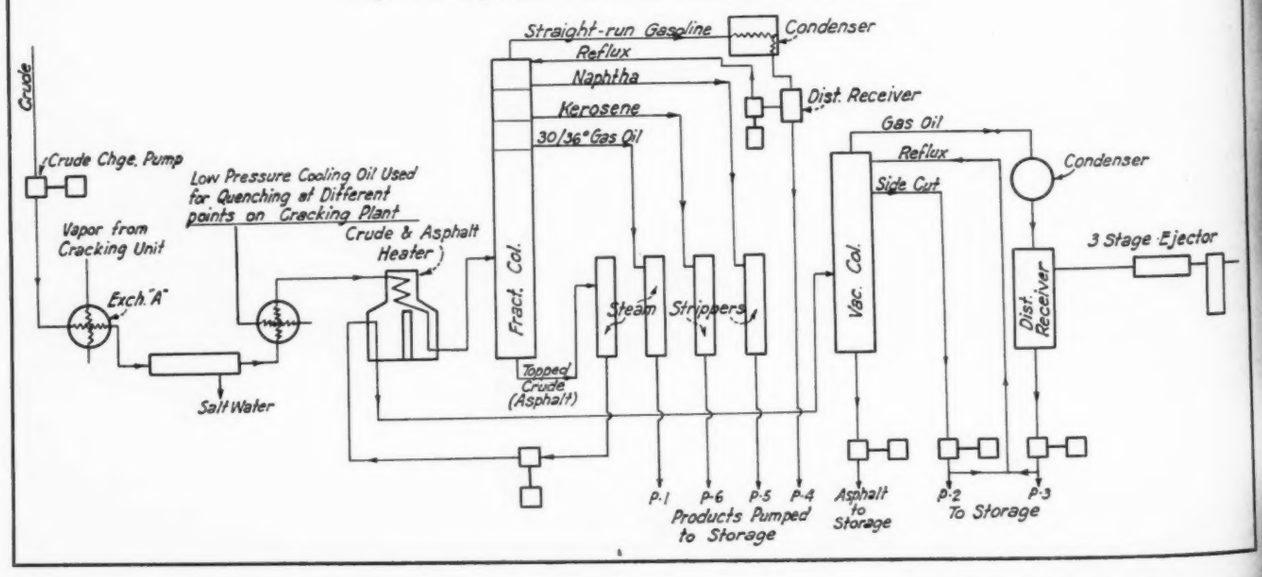
A feature of the cracking unit is the use of four to six percent chrome and one-half percent molybdenum in the piping, furnace tubes, valves, fittings, and pumping equipment carrying the hot oil. Reaction and flash chambers and cracked fractionating column are ganister-lined. These precautions are taken to combat corrosion.

The operators in the control room may know by observing an instrument board what is going on in each still, heater or vacuum tower on the grounds. It is an easy matter for those on duty to control completely the refining processes. All mechanical and chemical operations of the plant are regulated from one 40-ft. by 140-ft. fireproof building and in the same building all transfer pumps for light products are situated.

The liquid levels in the vacuum column and in the fractionating column are indicated as being high, medium, or low by three lights of different colors arranged vertically on the control board. Two pressure-reduction valves, one on the outlet from the reaction chamber and the other on the outlet from the reforming heater, have extensions permitting operation from the control room. Tower temperatures and pressures are controlled automatically by air-operated valves.

Gasoline, road oils, asphalt fluxes,

Fig. 1. Straight-run and vacuum distillation flow sheet



TIME'S MONEY

-IT PAYS TO DRILL OUT IN 36 TO 48 HOURS WITH 'INCOR'

BRIGHT and early on a Tuesday morning, the protection string on a Gulf Coast well was cemented with 500 sacks of 'Incor'. Wednesday afternoon, less than 36 hours later, they drilled through. Cuttings came out hard as flint. No three-day wait for cement to harden. You can drill out days sooner with 'Incor'. And time means money.

'Incor'* makes a velvet-smooth, free-flowing slurry. Easy on the pumps, even at 15 or 16 lbs. High gel strength keeps out mud. That means a stronger, denser, longer-life shut-off.

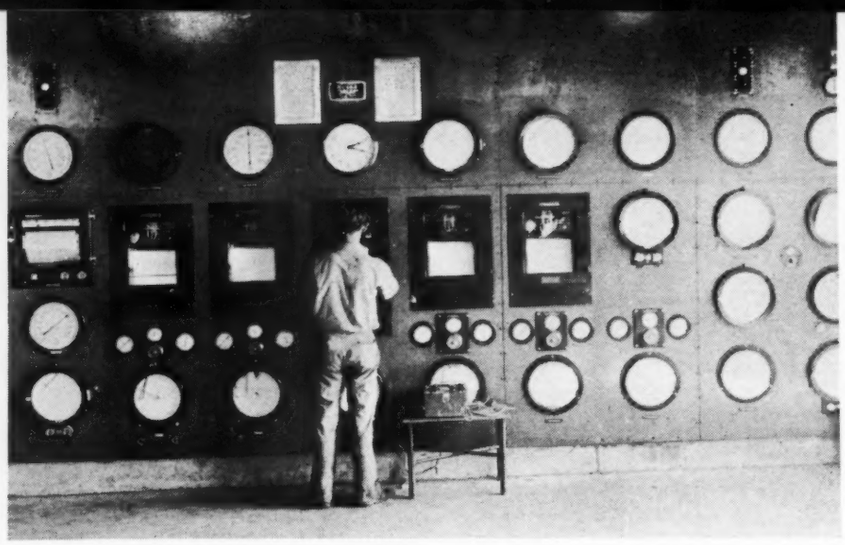
'Starcor' has the same properties—plus timed setting action for deep wells and high temperatures. Inbuilt safety factor allows ample time to put cement in place. And 'Starcor'* also gives extra protection where sulphate waters are active. Your nearby dealer can supply you, promptly.

*Reg. U. S. Pat. Off.

TWO PORTLAND CEMENTS—BOTH MADE FOR OIL WELLS

USE 'STARCOR'—for deep wells, high temperatures or extra sulphate resistance.

USE 'INCOR'—for wells of moderate depth.



Control board, the nerve center of the Talco plant. By means of this board every operation of the refinery is kept under observation and control

and specification naphthas are the principal products of the refinery. The plant has been producing asphalts and straight-run gasoline since June 26, and since the completion of the cracking units late in October has been producing 68-70 octane gasoline, non-leaded. It is expected to produce 2500 bbl. of this high octane gasoline daily. The gasoline is doctor-treated and inhibited.

Roofer's flux, rapid-curing and medium-curing cutbacks, and penetration asphalts were produced from the first. Now the plant can make slow-curing cutbacks and is equipped with two 12-ft. by 30-ft. shell stills in which air-blown asphalt can be produced. It is planned to use them only for making high-melting-point specialties.

Natural gas was the only fuel used in the refinery prior to the completion of the cracking units, but now all the fuel, except that used in the residences and by the gas-engine-driven electric generators, is obtained as a by-product of the cracking operations.

The two 200-kw. and one 100-kw. generators actuated by these engines supply current for all the electrical machinery in the refinery and for the lighting system, including flood lights on six 74-ft. fluted steel poles strategically situated on the grounds. Sixteen 1500-watt flood lights are mounted on these poles.

Steam is supplied by two low head boilers. Each is rated at 378 hp., but is capable of delivering twice its rated capacity. These boilers supply steam for jacketing the asphalt lines, for operation of the vacuum column, for certain of the pumps, and for clean-outs. Either boiler can carry the full load for which the two are designed while the other is being cleaned or repaired. There are two 400-cu. ft. air compressors to supply air for clean-outs, for construction work, and for blowing the asphalt.

The refinery has numerous provisions for preventing a complete shut-down should there be difficulties with one of the units. All essential electrically-driven pumps are provided with stand-by steam turbines. The cracking, topping and asphalt units may be operated independently.

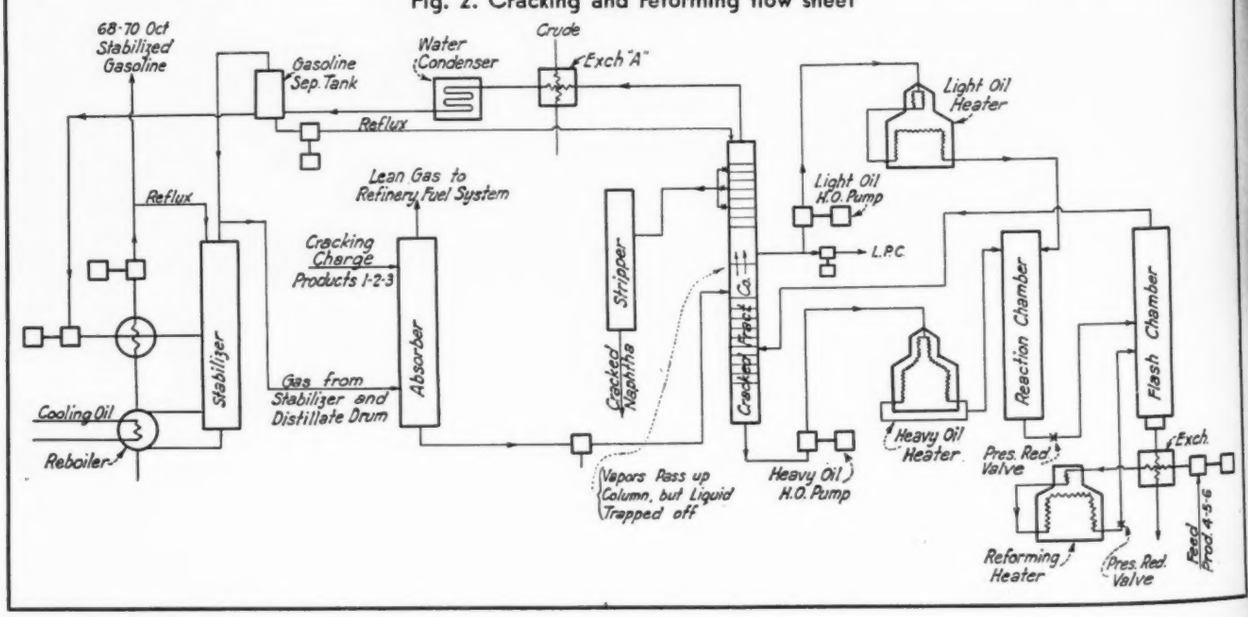
The cooling water system is designed to circulate 5600 gal. a minute. The Fluor tower is capable of supplying water at 85 deg. fahr. under summer conditions. Make-up water is obtained from a deep well that can supply 300 gal. a minute. The hardness of this well water is less than one grain, so the water is ideal for boiler feed use.

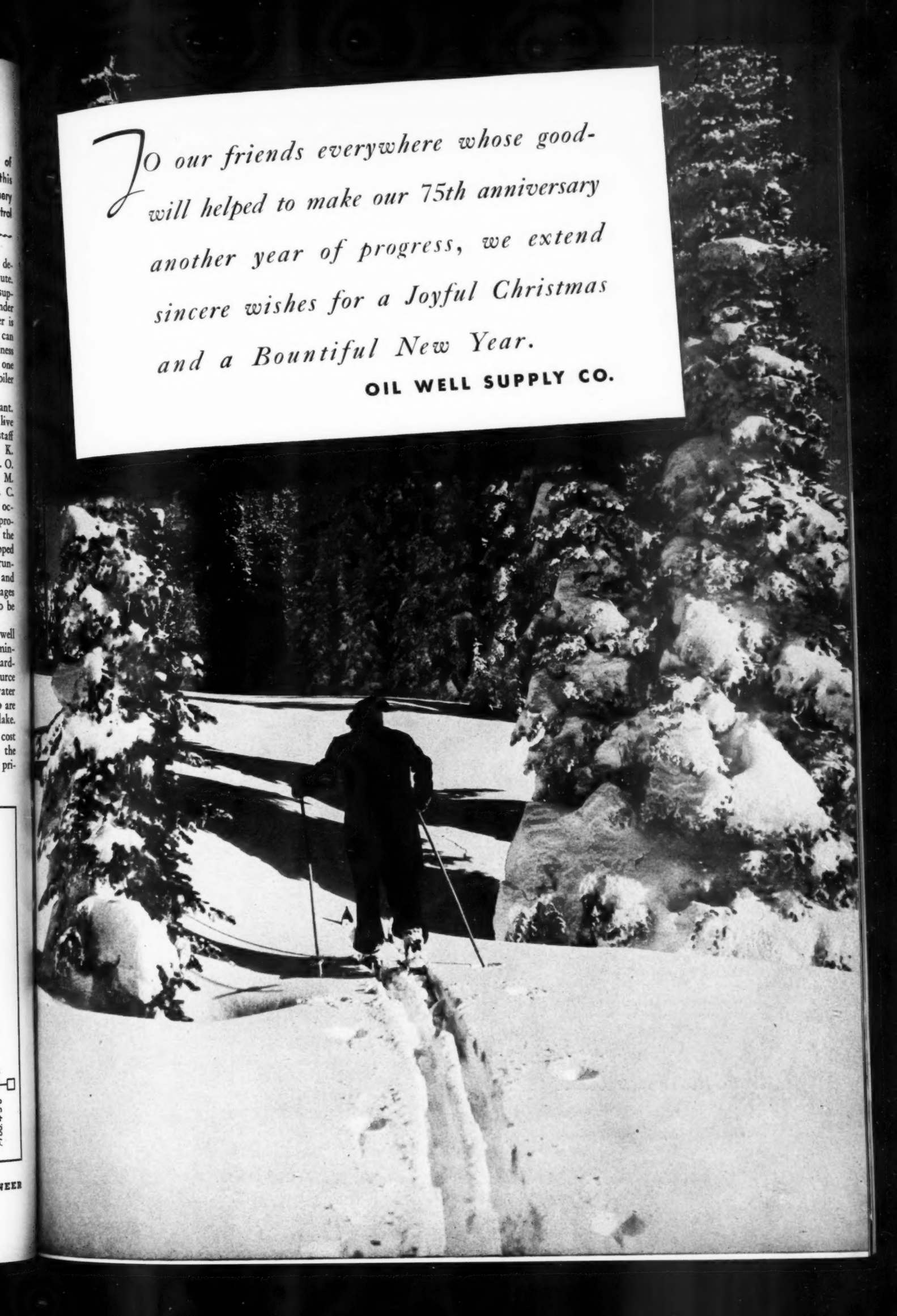
There are 45 employees at the plant. All except the officials' families live at Mount Pleasant. The technical staff includes the general manager, J. K. MacKinnon; the superintendent, C. O. Garbrecht; the chief chemist, J. M. Dom; and the plant engineer, J. C. Reed. Members of the official staff occupy modern, attractive cottages provided for them on the grounds by the company. Each cottage is equipped with natural gas, electric lights, running water, plumbing fixtures, and means of sewage disposal. All cottages face a 100,000-bbl. lake that is to be beautified.

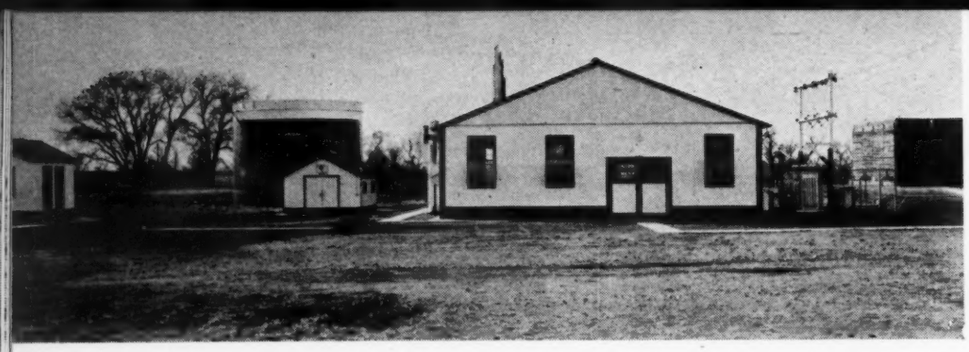
The lake is fed from a deep well having a capacity of 320 gal. a minute. The lake water, which has a hardness of nine grains, also is the source of supply for the refinery. The water make-up pumps and the fire pump are situated at the lower end of the lake.

The plant is reported to have cost $1,500,000 and is believed to be the only refinery in Texas designed primarily for producing asphalt.

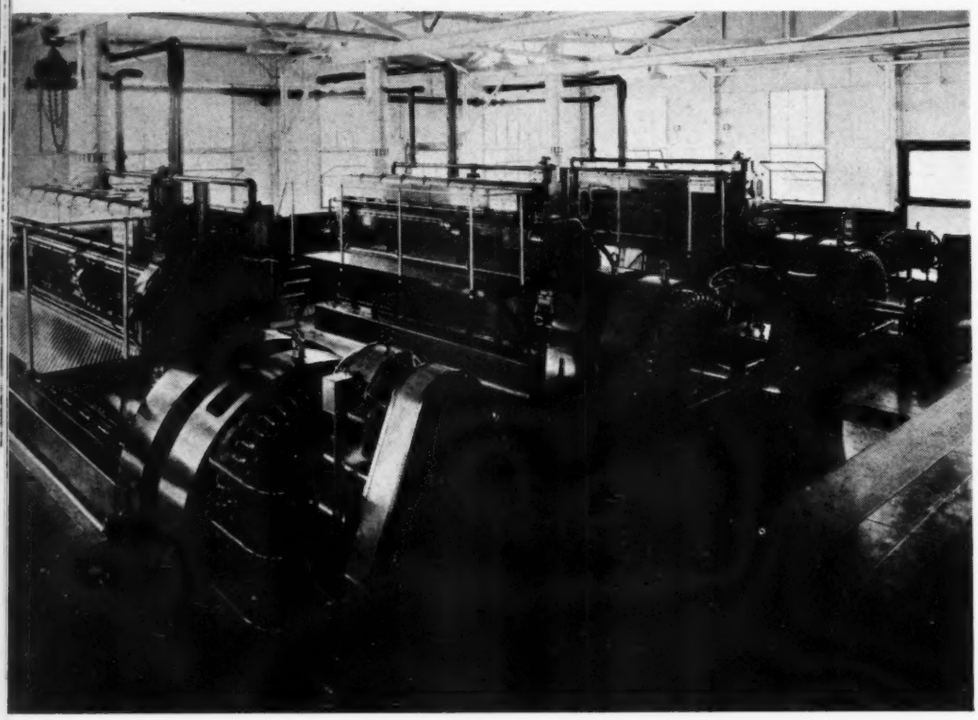
Fig. 2. Cracking and reforming flow sheet




To our friends everywhere whose good-will helped to make our 75th anniversary another year of progress, we extend sincere wishes for a Joyful Christmas and a Bountiful New Year.
OIL WELL SUPPLY CO.



Exterior view of the Moundridge power plant, showing from left to right: Office, pipe line pump station and tank, power plant, transformer banks, and cooling tower



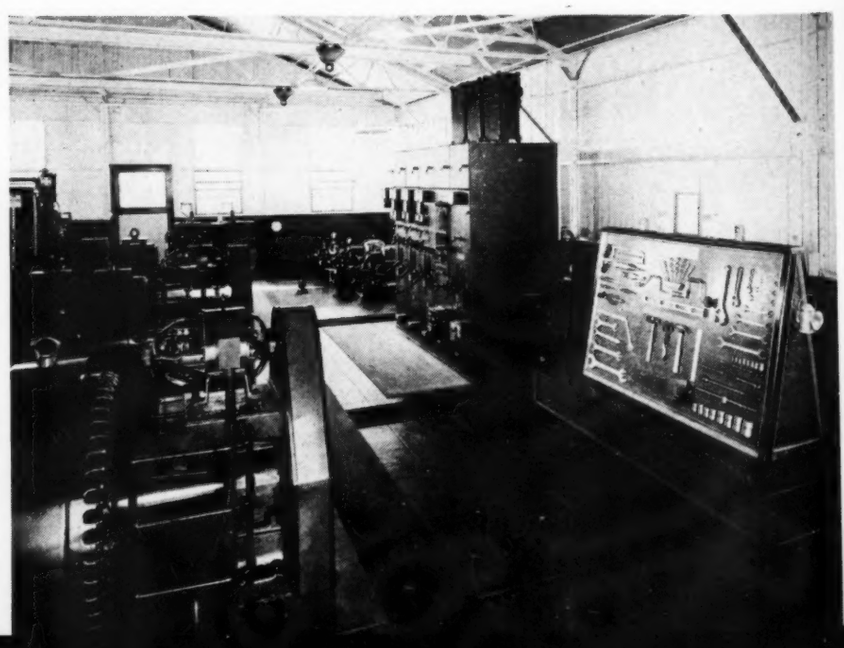
Interior of power plant, showing the three 333-kva. engine-generator sets

Field Plant Supplies Electric Power For All Field Operations

Pipe line station and all drilling and pumping wells obtain power from new Continental plant

By LEO H. TOWERS

CONTINENTAL Oil Company has just completed a power plant of sufficient size to electrify completely the field it serves. The Graber pool, northwest of Newton and near Moundridge, Kansas, is operated entirely by this one company. Not only does the plant supply power for pumping wells already completed but also provides power for the drilling of new wells and for pipe line pumping stations nearby. At the present time 56 wells are being



View along north wall of building, showing tool rack, switchboard, and water-circulating pumps

Place your stake

ON THESE 3 ACES IN THE HOLE!

NATIONAL

DRILL PIPE - CASING - TUBING

A.P.I.

X 8

WALLS WITHOUT WELDS

IF, in every hole you drill, you put your faith in these 3 Aces—NATIONAL Seamless Drill Pipe . . . NATIONAL Seamless Casing . . . NATIONAL Seamless Tubing, you will be assured of exceptional performance and utmost economy of operation.

Famed engineers outside the oil fields are amazed when they learn of some of the feats of both straight hole and directional drilling carried on in the past few years. A part of the credit, at least, goes to NATIONAL Seamless A.P.I. Drill Pipe for so ably transmitting the drilling power from the derrick floor to the bottom of the hole.

NATIONAL A.P.I. Seamless Diamond BX and Diamond B8 Casing is the best safe-guard against increasing casing costs. Being pierced from solid steel (Walls Without Welds), it has uniform wall-strength to meet any "rough going" in running or cementing and remain sound and dependable; it stabs easily and screws together smoothly and accurately.

Heavy upset ends give NATIONAL A.P.I. Seamless Tubing extra strength and toughness where needed and afford abundant wearing metal that permits it to be made up and broken down time after time.

For profitable drilling, casing and tubing of wells, place your stake on these 3 aces in the hole, NATIONAL Seamless —America's Preferred Drill Pipe, Casing and Tubing.

Made by the World's largest manufacturer of steel pipe and tubes.

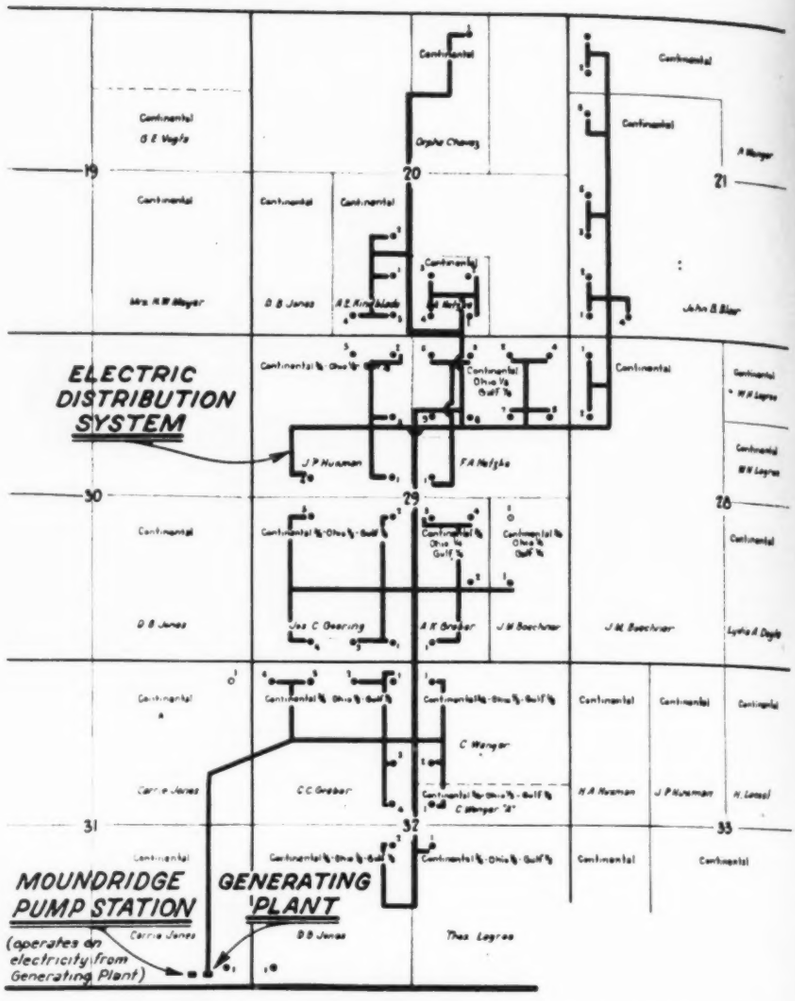
NATIONAL TUBE COMPANY

PITTSBURGH, PA.

United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

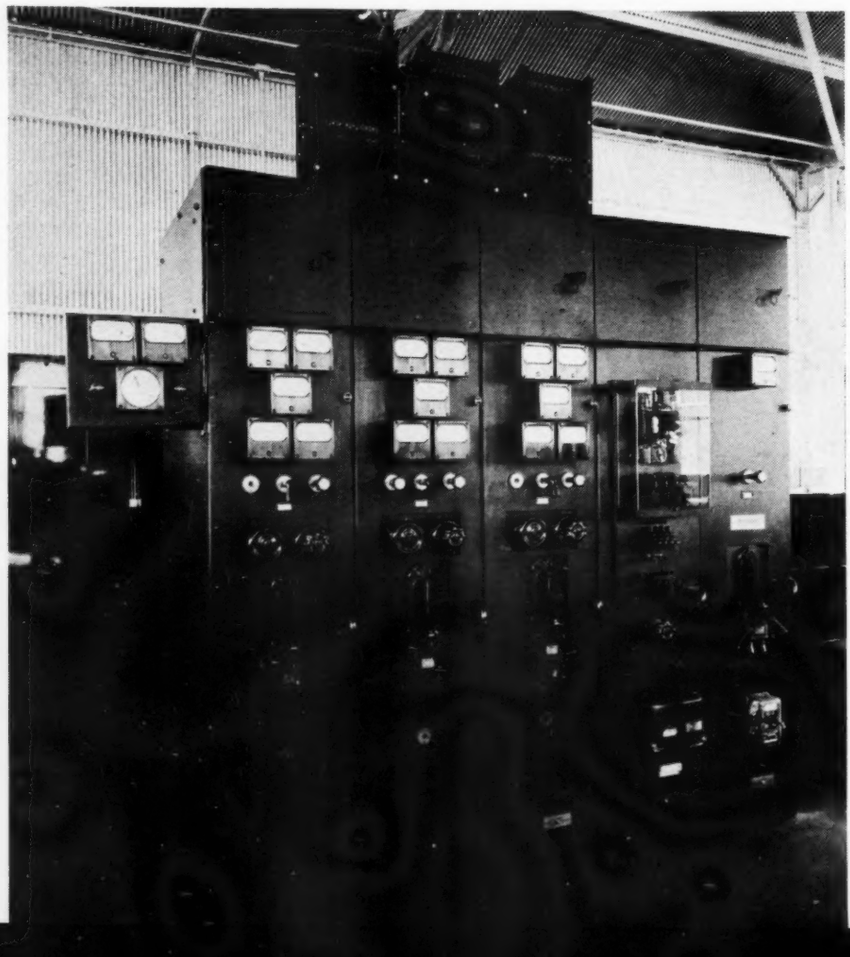
Map of the distribution system of Continental's Moundridge generating station



pumped; two rotary rigs are drilling; two cable-tool drilling-in rigs are in operation, and one pipe line reciprocating pump is operated from this power. The rotary rigs are owned and operated by a drilling contractor under contract with the Continental Oil Company.

This modern 1200-hp. power plant, known as the Moundridge Plant, was constructed to handle the estimated future load required when the pool is completely developed; however, at present the power demand averages only 58 to 65 percent of capacity. Wells in the field are approximately 3300 ft. in depth on an average and there is approximately 360,000 ft. of hole yet to be drilled. As the number of wells completed and put on the pump increases the power demand eventually will equal the capacity of the plant. When this occurs one of the drilling rigs will be withdrawn from service and the remainder of the field drilled by the one electrically-driven rig and a rig powered by steam or internal combustion engine.

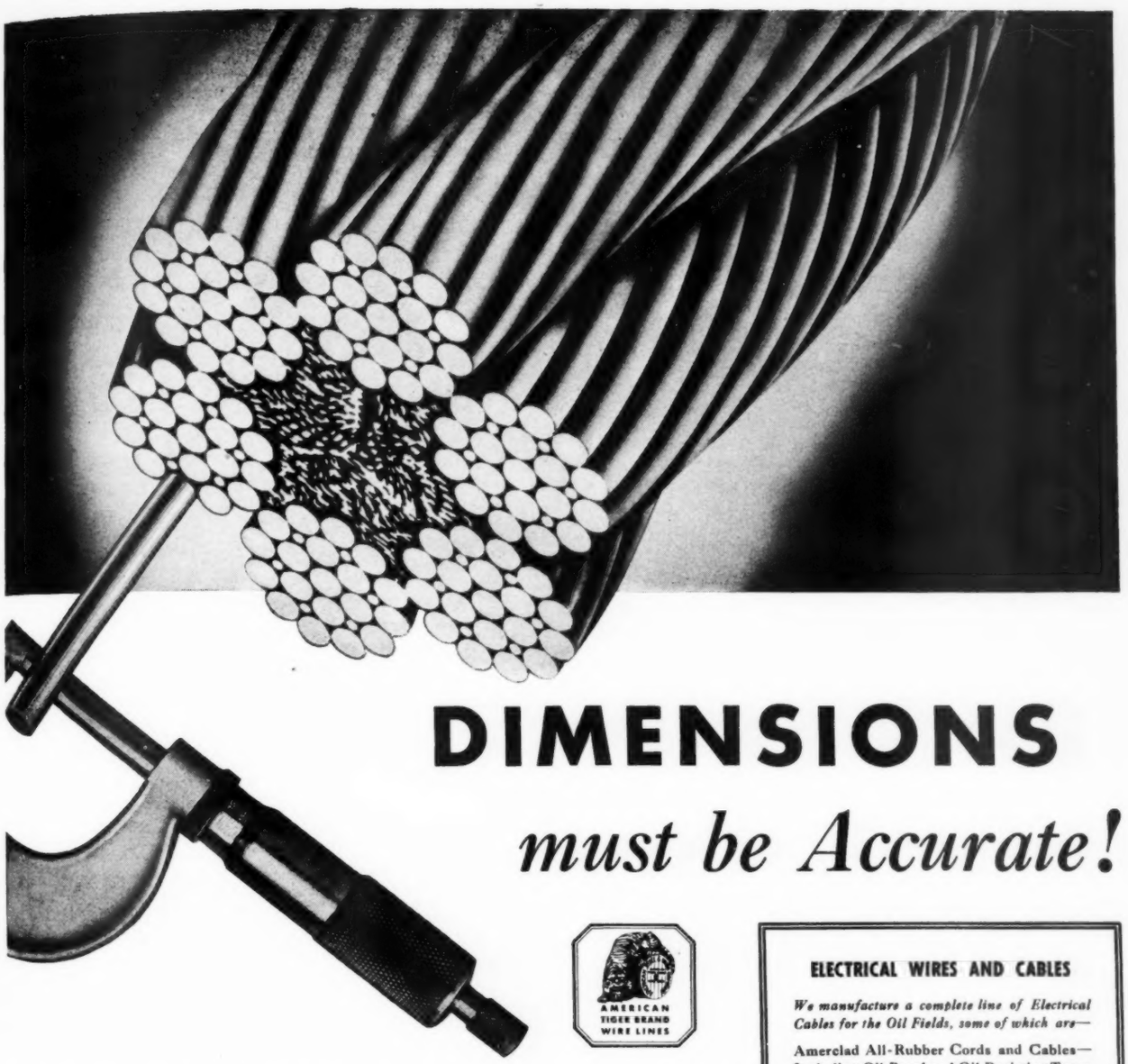
The power plant is situated at the southern edge of the field adjacent to the company's pipe line pumping station and is operated by the personnel in charge of the pipe line station. The overhead cost of operation is materially reduced by the division of pay-roll between the two stations. As the plant is fully automatic it requires little attention from the crew except for routine oiling and occasional repairs.



Close-up of the 5-panel switchboard

Generating equipment in the plant consists of three 400-hp., 400-r.p.m., 8-cylinder, 11½ by 13½ Cooper-Bessemer gas engines direct-connected to three 333-kva., 2300-volt, 3-phase, 60-cycle, 400-r.p.m. Westinghouse generators. The 7.5-kw. exciters are belt driven from the main shaft. To aid in compensating for the variation in load caused by the drilling rigs the engines are equipped with extra heavy fly wheels. The engines are so designed that they may be converted to full Diesel operation if desired.

Fuel for the engines comes from the field lines but before being used it is passed through a scrubber situated just outside the plant building. All jacket water is treated before entering the closed cooling system. Three motor-driven centrifugal pumps are situated



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That is the kind of service you can expect from American Tiger Brand Wire Lines. They are the product of engineers who have specialized for years in their design and they are backed by more than 100 years of wire-making experience.

American Tiger Brand Wire Lines are available in either Standard (non-preformed) or Excellay (preformed) constructions.

*American Tiger Brand Wire Line is a machine, more complicated than many, fitting the definition "Any combination of mechanism for utilizing or applying power."

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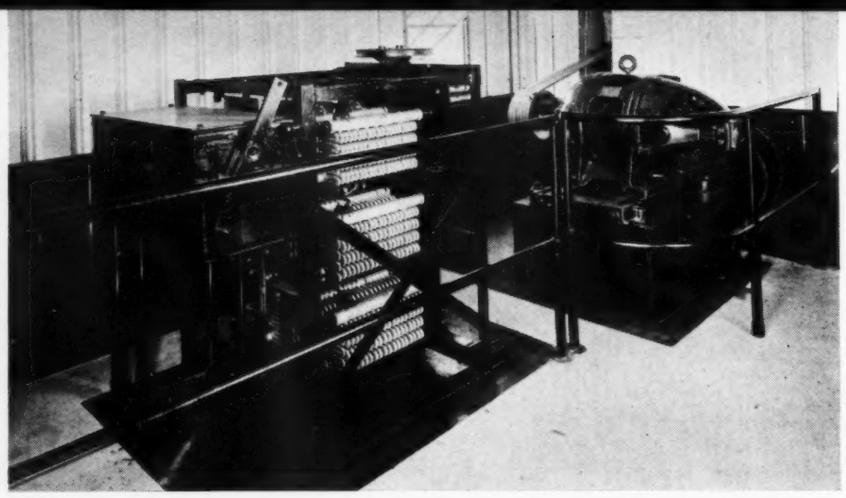
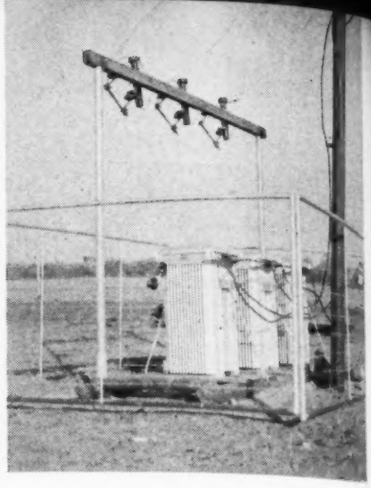
UNITED STATES STEEL



Interior of the engine house at one of the pumping wells in the Graber pool, showing a 15/35-hp. induction motor



Portable transformer bank made by mounting the transformers, switch, and meter on skids for easy transportation from one drilling location to another

in one corner of the building. One of the pumps circulates water from the engines through the cooling tower, back to the standpipe, and then to the engines again. A second pump lifts the raw water from the cooling tower pit to the top of the tower where it sprays over the coils of the closed system. A third pump is manifolded to serve as a standby for these two units.

The 5-panel electrical control board is composed of steel and is totally enclosed front and rear. There is one section or panel of the switchboard for each of the three generators. The fourth section contains the automatic voltage regulator and the fifth section the meter and switch on the outgoing line. If one of the engine-generator sets were to be removed from the plant the corresponding section of the switchboard could be removed also without disturbing the rest of the board.

The only other auxiliary equipment in the building is a small air compressor and an air storage tank for engine starting. The office is in a separate building between the power plant and the pump station. The power plant floors, walls, and equipment are models of cleanliness and neatness in keeping with Continental's standard method of housekeeping.

Three transformer banks are situated just outside the building. A step-up bank increases the voltage from 2300 to 11,500 volts for transmission to the field. The two smaller banks step-down the current to 440 volts and 110 volts for small motor operation and for plant lighting, respectively. Approximately eight miles of line carries 11,500 volt power to all parts of the field.

All pumping wells are being driven by 15/35-hp. induction-type motors. On the low side the motors run wide open for ordinary pumping. For a cleaning-out job requiring additional power the high side of the motor is connected. Static condensors are being installed that will increase the present power factor for this installation from 60 or 65 percent to 80 or 85 percent.

Field transformers reduce the line voltage to 440 at each well take-off. A portable transformer bank, switch, meter, and uprights mounted upon skids save time and labor in making connections when moving from one drilling location to another.

Very substantial savings are shown between the cost of purchased power and generating cost at the Moundridge plant.

New Era in Manufacture and Use of Steel Seen

AMERICA is entering a new era in the manufacture and use of steel in which man's most useful metal will be "tailor-made" for a wide variety of uses, Dr. John Johnston, director of research of United States Steel Corporation, said at a meeting of The Franklin Institute in Philadelphia recently.

"A generation ago the technical problems facing the steel industry were related mainly to increased production of a few kinds of steel," he said, "but today the object is to improve the fitness of steel at no greater over-all cost to the public."

"As a result," he continued, "we are able to build structures which are lighter in weight for a given load, or which may be safely used under more severe conditions of stress or temperature. It will permit progress in several industries, now hindered or stopped for lack of a suitable metal.

"In fact the trend for many years has been towards lighter steel products, due in part to the substitution of thinner for thicker material at a rapidly accelerating rate during the last two or three years."

The sheet steel used for automobile fenders was cited as one example of this trend. Approximately half as thick as it was a decade ago, its thinnest part is now only about two hundredths of an inch thick.

"Substitution of thinner for thicker material means that in service the metal is subject to a higher unit stress and in general is not safe unless the metal has an appreciably higher resistance to atmospheric corrosion," Dr. Johnston explained.

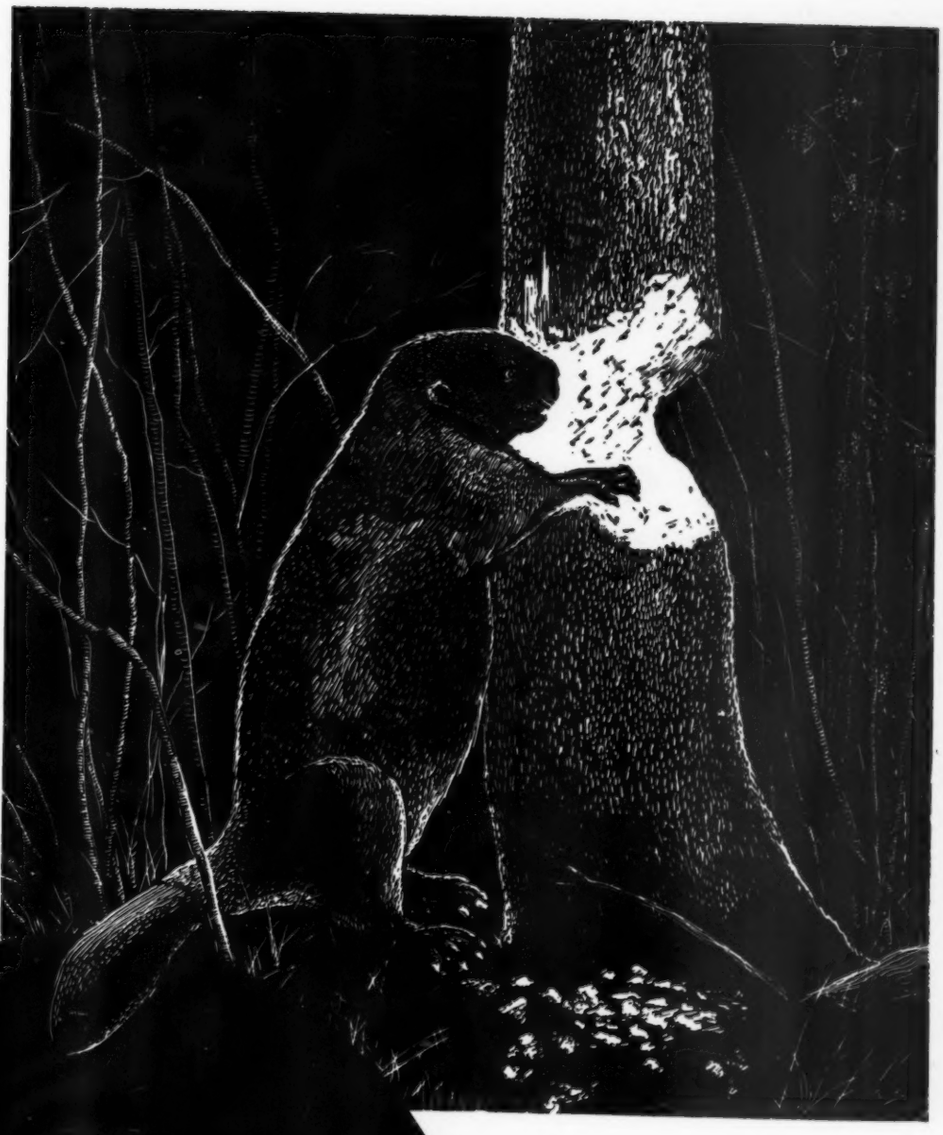
"The thinner the metal the greater the relative weakening of the structure caused by a given depth of corrosion. Therefore, weight-saving steels must be both stronger and more resistant to corrosion.

"Meeting the requirement of strength has not been so difficult as that of greater corrosion resistance. Constant research and hundreds of systematized tests have made such a steel available.

In discussing corrosion, Dr. Johnston said that the addition of certain elements to steel gave it the property of forming an oxide coat that proves to be a better protection against further corrosion than ordinary rust.

This weight-saving steel falls in the family of high-tensile steels of which the familiar stainless product is a prominent member.

An outstanding reason why we are on the threshold of a new era in steel making is that the atomic behavior of iron on heat treatment is being better understood and put to practical application by man, Dr. Johnston stated.



While the Beaver is one of the smaller wild animals—his talents are many—and his deeds often great. Nature gave him teeth capable of cutting down full grown trees—and doing it quickly, evenly and with the least lost motion.

HUGHES TOOL COMPANY, HOUSTON, TEXAS, U. S. A.

Bleaching Clay

Classification of bleaching earths and improvement of their bleaching power

Part 5

By RAFAEL FUSSTEIG

As various bleaching earths are used for treating petroleum products, their selection by refineries is more and more exact. Adsorbents of mineral origin may be prepared synthetically, or they may be found in nature. The synthetic adsorbents include ferric hydroxide gel, silica gel, and alumina gel, as well as combinations of the latter two. Of these synthetic absorbents, silica gel is best known, and is used to some extent for refining petroleum products, but the high cost of such adsorbents retards their widespread use.

The quantity of natural mineral adsorbents used in the refining of petroleum is great. It is estimated that more than 97 percent of the annual production of bleaching clays is thus consumed. In the United States, the chief sources of these bleaching clays are: Arizona, southern California, Colorado, Florida, Georgia, Illinois, and Texas. These products must be divided into two categories, the first being the natural bleaching earths, and the second a rough material for artificial activation, that is, for the leaching process. This rough material is known as bentonite, or rarely as otaylite.

The first group, the natural bleaching earth, includes several sorts. Fuller's earth should be placed first because it was first to be discovered. In 1891 John Olson discovered it in Arkansas. In 1893 a deposit of Fuller's earth was discovered at Quincy, Florida, that proved to be especially applicable to the bleaching of petroleum. The sources near Quincy, together with those of other parts of Florida and southwestern Georgia, have from that time supplied all the Fuller's earth used in the refining of mineral oils.

Recently Prutzman and Bennison* have found another sort of natural bleaching earth. According to the studies of these investigators, this earth is a hydrosilicate of magnesium of the following composition:

Silicic acid	60 percent
Magnesia	27-32 percent
Water	4-12 percent

It belongs to the group of serpentine and talc. This natural bleaching earth has been established as very adsorbent for treatment of gasoline, lubricating oils, and paraffin waxes. In general it is white, soft and calcareous, light and porous. In the dry state, it floats on the surface of water. It contains different impurities such as clay, carbonates and oxides of magnesium and calcium, calcium silicates, insoluble sulphates and chlorides, etc. Some of these impurities can be removed easily. Clay in this earth represents a diluting agent, and is of no importance if present in small amounts.

In general, the above-mentioned magnesium hydrosilicate is used in the percolation process. For this purpose it must be dried before using; however, a limited temperature should be used. If overheated this earth loses its adsorption power. The dried product should contain approximately five percent water. This dry bleaching earth is then ground and passed through sieves of 15 to 30 mesh, 30 to 60 mesh, and 60 to 90 mesh.

To increase the bleaching power of the magnesium hydrosilicate, concentrated sulphuric acid can be added to the fine-grained material. This mixture forms a paste that, when added to the hot oil, is able to decolorize it. Of course, the correct proportion of earth and acid content is of great importance. When this proportion is correct, the bleaching earth will be distributed, during the refining process, in the form of fine, black flakes. In case the bleaching earth is distributed in the form of hard grains or clots, it indicates that insufficient acid was added. Hydrochloric acid can be used instead of sulphuric acid.

A third kind of natural bleaching clay is Filtrol. It is a natural silicic acid in colloidal form, that is, of microscopic structure, containing seven percent aluminum silicate, and small amounts of oxides of aluminum and magnesium, as well as traces of iron.

It has been determined that Filtrol has a considerably greater adsorption power than Fuller's earth. In addition to these characteristics, it is able to absorb sulphur compounds, and, therefore, it is used in the bleaching of oils rich in sulphur compounds; moreover, Filtrol can be used at a lower temperature with a satisfactory bleaching effect. For this reason Filtrol can be used in the refining of highly-viscous lubricating oils, using moderate temperatures.

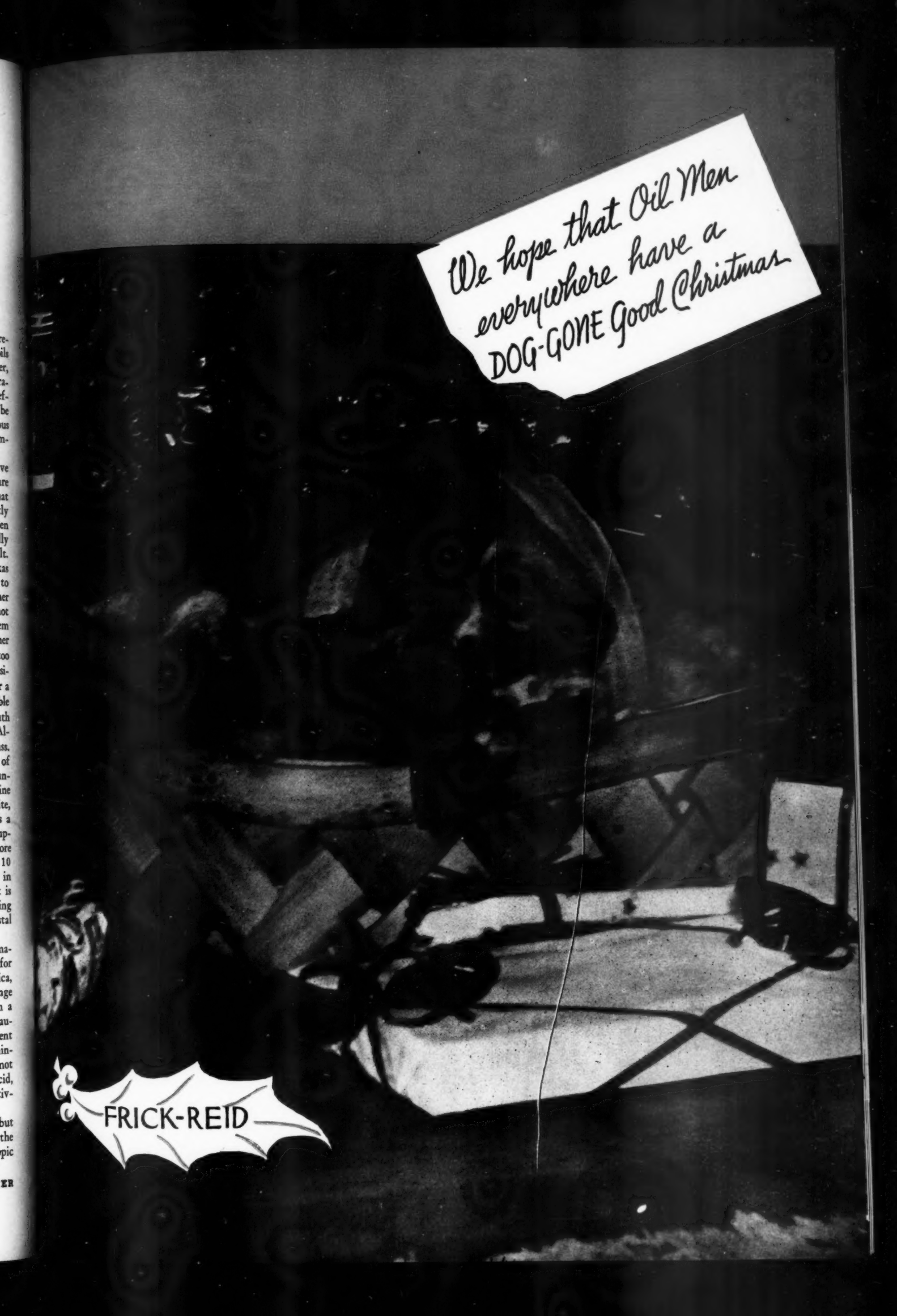
As mentioned, clays of the inactive type but that can be activated, are largely bentonites, volcanic ash that has been decomposed and partly leached. Where bentonites have been redeposited by water they are usually mixed with ordinary clay and silt. Most of the Oklahoma and Texas clays that can be activated appear to be of this character. In some other bentonites the decomposition has not progressed far enough to render them readily responsive to activation. Either the volcanic ash was originally too silicic or the climatic and other physical conditions were not favorable for a decomposition to a highly activatable type of clay. Those of Wyoming, South Dakota, western Montana, and Alberta appear to be chiefly of this class.

A third possible major source of bleaching material is the very abundant and widely distributed marine deposits of the mineral glauconite, commonly called greensand. This is a complex ferromagnesian silicate supposed to have been formed off-shore at the "mud line" of the ocean in 10 to 100 fathoms of water, probably in connection with animal life, and it is now found in deposits of varying thickness along the eastern coastal plain.[1]

Glauconite long was used as a natural fertilizer. It has been worked for potash, for iron salts, and for silica, and is being used as a base-exchange water softener. It grinds readily in a flour mill and the raw ground glauconite (300 mesh) is an excellent bleaching clay for cotton oil. For mineral oil (contact process) it must not only be ground but leached with acid, that is, submitted to an artificial activation.

The leaching process is nothing but the removal of soluble salts from the microscopic and ultra-microscopic

*General Petroleum Corporation, Los Angeles.


We hope that Oil Men
everywhere have a
DOG-GONE Good Christmas
FRICK-REID

channels of the clay. The empty channels more readily remove the impurities from the oil. It appears from the above that the more leached a bleaching clay, the greater its adsorptive power; however, too thorough leaching causes formation of very thin walls of the microscopic channels, resulting in the complete destruction of the microscopic structure.

In the early days of the development of the oil refining industry, the moderately active natural bleaching clays, that is, the Fuller's earths, accomplished their function, but the demand for certain highly decolorized oils has been so great during recent years that investigators have been examining intently all possible methods of improving the bleaching effect of clays. Kohlendorfer[2] was the first to find that the leaching process is able to improve the bleaching effect of clays. He ground a clay and mixed it with ten percent of sulphuric acid at a temperature of 100 deg. centigrade. He then neutralized it with ammonia, and after this process he filtered and dried the activated clay. Thus, Kohlendorfer obtained a bleaching clay with an improved bleaching effect. This leaching process did not lead to a satisfactory result, however, because the leaching process had not been carefully performed. Besides, this investigator did not establish the fact that the concentration of the acid plays a very important role.

This new method has caused the development of a quite new industry. Various methods have been proposed to increase the bleaching effect of clays, most of them being a secret of the manufacturer; but nearly all these secret processes depend on the leaching of inactive but activatable clays with the aid of concentrated hydrochloric acid or sulphuric acid under proper conditions. Two factors play the most important parts in the leaching process: the maintenance of a definite concentration and of a definite temperature during the leaching process. In general, this process proceeds as follows: After the clay has been thoroughly mixed with the treating solution and a uniform pulp or mud obtained, the pulp is heated to a temperature of 100-110 deg. cent., and held at this temperature for several hours with occasional agitation. During this treatment the acid attacks the clay, transforming a portion of the silicates to sulphates, and sulphates of aluminum and magnesium are obtained in large quantities. After the cooking some acid remains, which does not react with the clay, and this acid, presumably, indicates a condition of equilibrium between the acid and the clay. All the carbonates in the clay are destroyed. After cooking, the hot pulp is diluted with water and agitated with air to mix thoroughly and to dissolve as much of the salts and acid as possible. After vigorous agitation for a short period and settling until the water is comparatively clear the clay is submitted to a wash with water.

The residue from washing contains little free acid. After a final wash the pulp contains 75 to 80 percent water. Part of this water can be removed by filtration. It is advisable to use a continuous filter. The drying of the treated clay requires a close control of temperature if heat is used, the clay being very susceptible to overheating and consequent impairment of efficiency. Drying of the treated clay on a small scale is best accomplished by simply exposing the clay to air. Air-drying in the manner suggested will reduce the moisture to about 30 percent. The structure of the treated clay is so delicate that overheating will change it readily.

If we now inspect this process, we see great difficulties in its operation. Maintaining the acid concentration causes special difficulty. The consumption of the admixed acid and water proceeds rapidly during the leaching of the clay, resulting in a complete drying-up of the paste. This causes an overheating of the solid mass, which destroys the structure of the microscopic channels.

For this reason different procedures are used to prevent the alteration of the concentration during the leaching process; however, not all these methods are able to solve this problem entirely. It is true that the evaporation of the admixed acid and water takes place in these proceedings very slowly, but a definite concentration can not be maintained indefinitely. Therefore, these methods are only applicable for clays containing in the microscopic channels silicates that can be dissolved easily in the hot concentrated acids, that is, silicates that can be leached in approximately four hours. There are also many sorts of clays that contain in the microscopic channels silicates that are only slightly soluble in the concentrated acid or whose microscopic channels are very sensitive to the action of concentrated acids. Under these conditions, the leaching process must be continued for a considerably longer time, 10 to 24 hours, using in the first case a concentrated acid, and in the second a dilute acid.

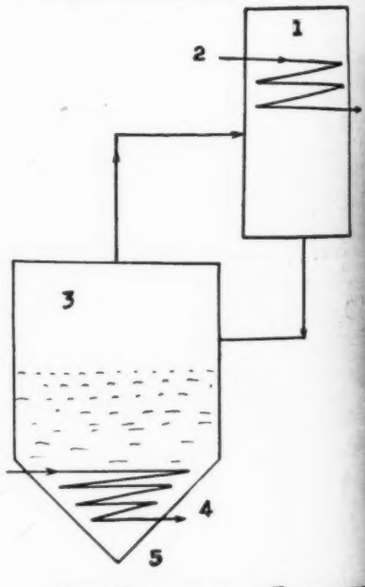
To overcome these disadvantages, the writer has changed the leaching agitator in such a manner that it acts now as a distilling vessel whose dephlegmator condenses continuously the evaporated acids and water, allowing them to return to the vessel. It can be seen that this operation maintains the acid concentration. In operating this process the paste of the clay and acid is heated in the agitator by admitting superheated steam to the coil inside the agitator. The flow diagram is shown in Fig. 1.

In an attempt to improve the leaching process the writer added salts to the leaching acids, i.e., chlorides of potassium or sodium (or the sulphates when using sulphuric acids) and found that the leaching progresses at maximum activity, due apparently to the formation of acids in nascent state, these acids having a greater leaching strength than the corresponding ordinary acids. Even clays difficult to leach have responded to this method of treatment.

Instead of acids, alkalies can be used for the leaching process. The "Kochelwerk Aktiengeselschaft fuer chemische Erzeugnisse, Berlin," has patented[3] a procedure that activates clays poor in zeolites with alkaline solutions of organic compounds, under a higher pressure. The quantity of alkalies added should be as low as possible, to prevent the formation of water-soluble silicates. This procedure is as follows: Bleaching clays of inferior quality are reduced to mud with water. One kilogram of a brown coal that has been decomposed by means of alkali, is added to the paste, and one kilogram of water glass is added to this mixture. This mixture is then heated to the proper temperature, and cooked until the starchy mixture is transformed into a thin liquid paste. After cooking, this pulp is neutralized, washed, and dried.

(Continued on Page 70)

Fig. 1. Flow diagram. 1. Dephlegmator. 2. Cooler. 3. Leaching agitator. 4. Steam coil. 5. Direct steam



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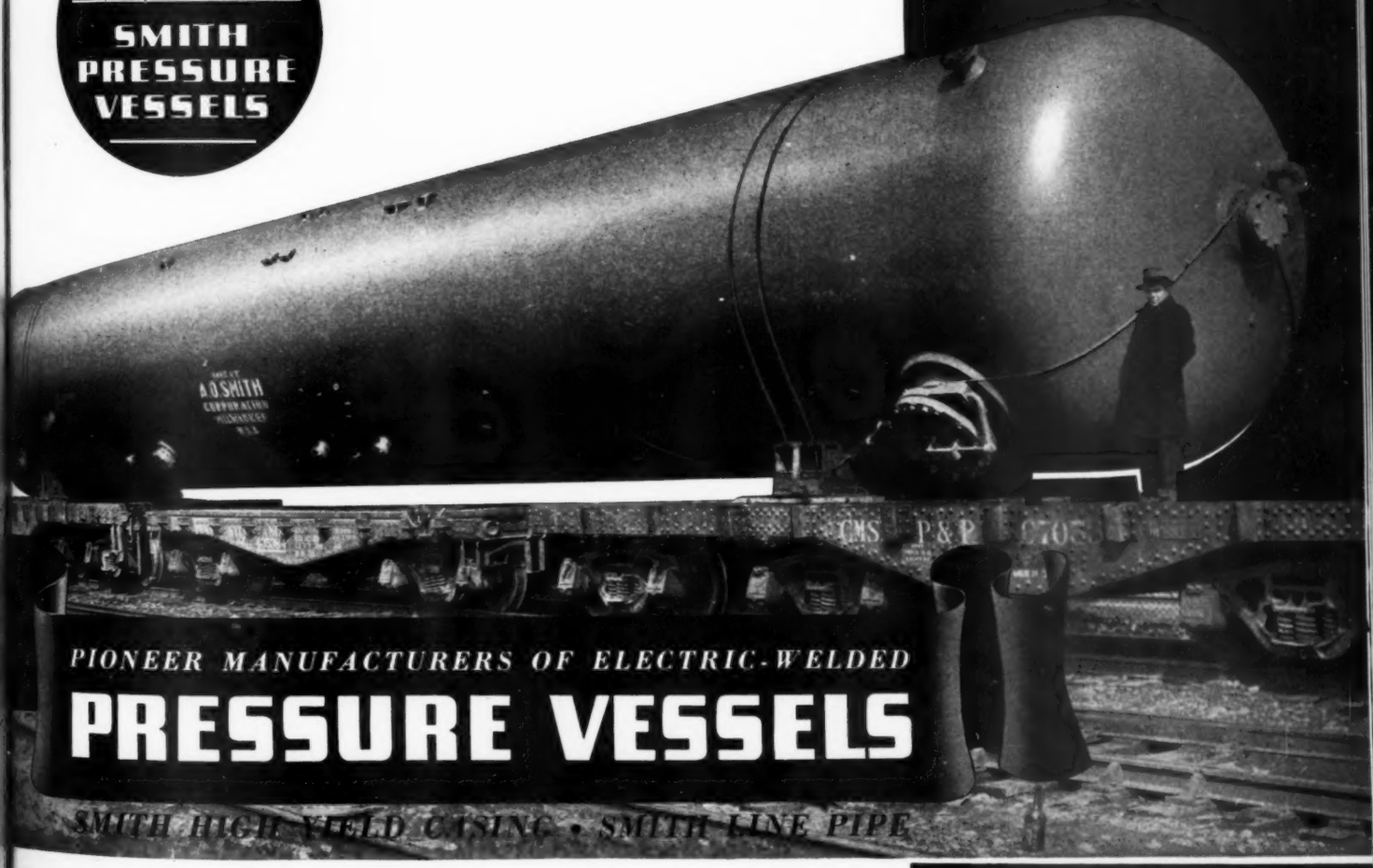

PIONEER MANUFACTURERS OF ELECTRIC-WELDED

PRESSURE VESSELS

SMITH HIGH YIELD CASING • SMITH LINE PIPE

(Continued from Page 66)

The "Tonwerk-Mosburg"[4] propose a process that consists of adding alkalies or water glass to the silicate. After evaporation, an acid is added to the mixture, and submitted to the activation process. J. G. Cloke[5] activates silicates with the aid of hydrofluoric acid. In this process the concentrated sulphuric acid is added to the raw material. After a thorough mixing calcium fluoride is added in finely-powdered state. The cooking of this mixture is continued until the pulp is thick. E. W. Rembert[6] activates silicates by permitting the raw material mixed with basic oxides, or hydroxides of alkaline earths, to go into chemical reaction with water or alkalies. According to this patent, a highly-activated bleaching earth is obtained.

The efficacy of natural bleaching clays, that is Fuller's earth, can be improved also by submitting them to different proceedings. The chief improvement consists in heating the natural bleaching clay to the proper temperature to enlarge the microscopic channels. Ch. C. Ruprecht[7] improves the efficiency of Fuller's earth by removing the water of crystallization, which is accomplished by the process of exsiccation. Then the earth is treated with a colloidal solution such as glue, albumin, mineral colloids, etc., a part of this solution is removed, and the bleaching clay is dried.

Addition of activated charcoal to bleaching clay is employed to improve the bleaching effect. It is actually true that an improvement of the bleaching effect is obtained by using a mixture of activated charcoal and bleaching clay in the bleaching of oils, but it is also true that these components, when used separately yield no favorable result. The reason for this is the great difference in length and breadth of the microscopic and ultra-microscopic channels of the bleaching clay and activated charcoal. As a result, during the bleaching process these two components acting together completely adsorb colloidal and crystalloidal matter.

Viewing the bleaching process in the light of the above we are forced to the conclusion that some bleaching clays adsorb color in oil better than others. For each clay there appears to be an optimum of bleaching activity that has been but little investigated. Some clays crack even pure saturated paraffinic hydrocarbons, such as blended oils, while others do not. There are also certain sorts of bleaching clays that are able to oxidize the oil during the bleaching process in such a manner that the oil begins to burn. The bleaching effect of some clays is unaffected by ignition but that of many clays is destroyed. One bleaching clay is inactive on hot crude when raw but is highly active after acid leaching, although on cotton oils its action is just the reverse.

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[2]D. R. P. 305,452.
[3]D. R. P. 407,618.
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[6]U. S. P. 1,945,534.
[7]U. S. P. 1,524,843.

Determination of Porosity of Oil Sands

INFORMATION regarding the pores or voids in reservoir rocks is vitally important in the scientific extraction of petroleum from natural underground reservoirs, states the Bureau of Mines, United States Department of the Interior, in a report recently issued describing the bureau's method of determining porosity of sandstones and other porous rock cores taken from oil and gas wells. The report also gives in tabular form the results of several hundred porosity determinations for oil sands in fields of 11 states.

The method of determining the effective porosity of oil sands, as developed at the Petroleum Experiment Station of the Bureau of Mines, Bartlesville, Oklahoma, falls within the general classification of gas-expansion methods and was developed as a part of the engineering research dealing with fluid and energy relations in natural reservoirs and improved oil-recovery methods. The apparatus and procedure are well adapted to the requirements of the bureau, and oil and gas operators generally should find the information useful in gaining further knowledge of fluid behavior in porous reservoir rocks.

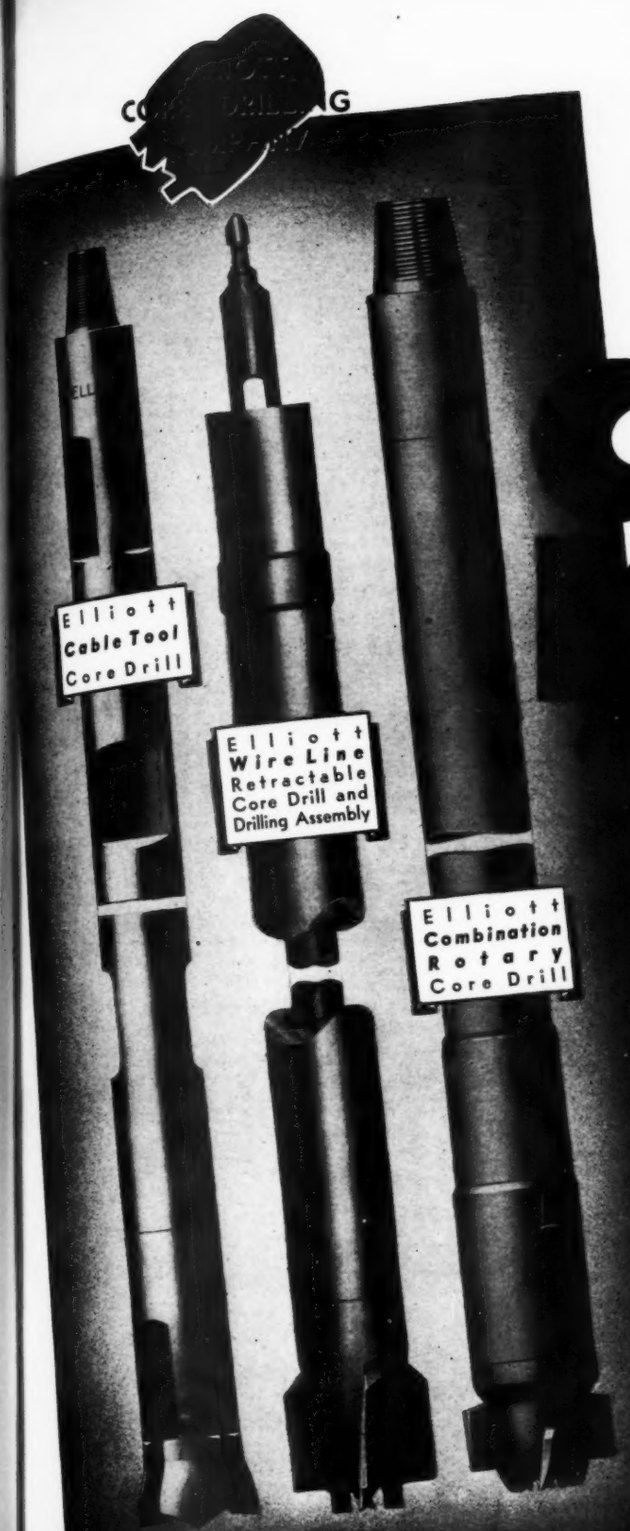
The Bureau of Mines method differs in various respects from others of the gas-expansion type. Pressures from 40 to more than 200 lb. per sq. in. are used rather than atmospheric pressure; also the gas is expanded to atmospheric pressure and the volume measured rather than expanded to a definite volume and the pressure measured.

The apparatus consists of a pressure bomb in which the test specimen is placed, equipment for measuring pressure, and a burette into which the gas is expanded and measured at atmospheric pressure. The use of a dead-weight gauge for measuring pressure is desirable, but a spring gauge may be used if it is calibrated carefully. The pressure bomb consists of a steel cylinder, 1¾ in. O. D. by 3¼ in. long; the corresponding inside dimensions are 1 in. by 1⅞ inches. The cap or cover of the bomb fits with a ground joint and is held tightly in place with a clamp. Bureau engineers have found that it is desirable to have the volume of free space in the bomb as nearly equal as possible to the bulk volume of the test specimen. This is accomplished by inserting in the bomb a number of steel disks having approximately the same diameter as the inside of the bomb, or other solid material, such as glass beads, depending upon the size and shape of the specimen. The burette, of a good grade, is graduated in tenths of milliliters, and has a capacity of 100 milliliters. Both the bomb and burette are operated in constant-temperature water baths.

The report describes clearly, by reference to an illustration, the step by step procedure for operating the instrument and shows the method of calculation whereby porosity values, expressed in percent, are obtained. Typical examples illustrate the application of the method, and tables assist the engineer in making necessary computations. A section discusses the accuracy of the method that is capable of giving very accurate results. The authors conclude that probably the greatest advantage of the method is that the test specimen is not affected in any way by the determination and is available for other tests; or, if it is desired, check porosity determinations may be made.

The porosity values given in the report should benefit engineers and others in their individual studies of oil and natural-gas field problems; however, all of the tabulated porosity values should not be considered to represent the average porosity of the formation from which the samples were taken. For many formations, only a few pieces of core were available, and the porosities measured may or may not be representative of the entire formation. It is shown that porosity may change as much as five to ten percent within one foot of sand depth.

Copies of R. I. 3352, A Method of Determining Porosity: A List of Porosities of Oil Sands, by D. B. Taliaferro, Jr., T. W. Johnson, and E. J. Dewees, may be obtained upon request, without charge, from the Information Division, Bureau of Mines, Washington, D. C.



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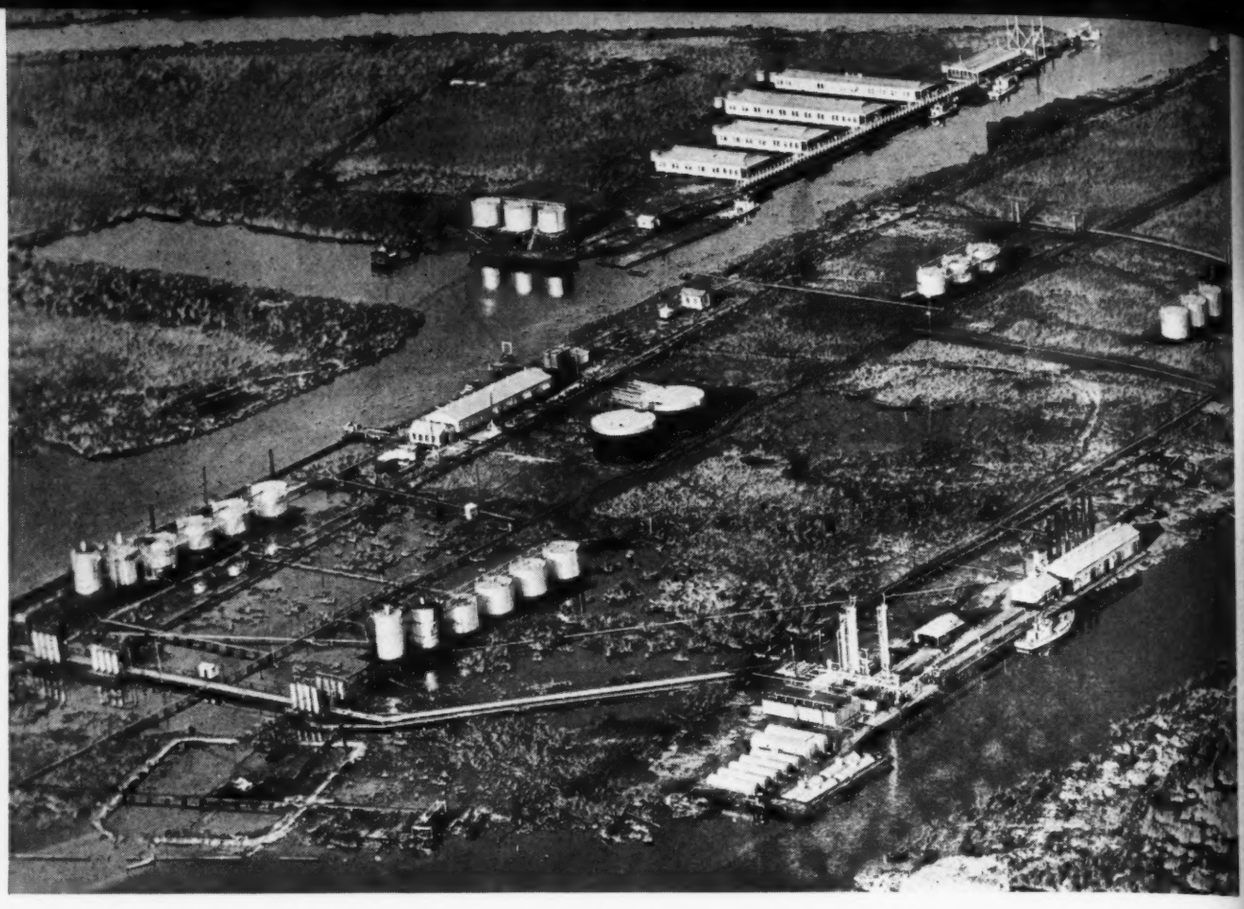

General view of The Texas Company's layout in Lafitte field. Gasoline plant is in right foreground. A part of the high- and low-pressure separators and stock tanks are to the left. Directly behind is the pipeline station, and in background is the company camp

Problems Attending Construction and Operation of Gasoline Plant in Marshland Area of South Louisiana

Provision of an adequate foundation, transportation of finished product, and supplying pure water for processing, a few of the factors involved

By FRANK H. LOVE

PROBLEMS not usually found elsewhere are encountered in the construction and operation of gasoline plants in the marshland areas of South Louisiana. Provision of an adequate foundation for the erection of the various units, transportation of the finished product, and the supplying of pure water for processing are a few of the several factors involved. The Lafitte field, 30 miles south of New Orleans, is such an area. Wells, of which there are 16 producing at present, are drilled from barges. Operating men must be transported to and from the job by boat, and the only means of entering the field are by boat or airplane. Recently The Texas Company, which owns and operates the entire field, erected a natural gasoline plant to utilize casinghead gas. The product manufactured is used for blending and a considerable part of the residue gas either is sold commercially or employed on leases for drilling and other purposes.

To obtain a foundation upon which to construct the plant it was necessary to drive piling varying in lengths from 45 to 70 feet. The piling was heavily creosoted to protect against termites and barnacles. Elevation of the plant is approximately five ft. above the mean water level. The piling was capped and floored with 3-in. planking, and on the plant platform proper a 6-in. reinforced concrete floor (50 ft. by 60 ft.) was built. All lead and residue lines, as well as walkways, also are carried on piling.

Operations of The Texas Company at Lafitte are concentrated on an island, shown in an accompanying illustration (Fig. 1); formed by the dredging of canals. The island isn't solid land, however; rather a marsh the depth of which is greater than the height of an average-sized individual. The various units, tanks, etc., are supported on piling. In the right foreground of Fig. 1 can be seen the gasoline plant. To the left is a part of the high- and low-pressure separators and stock tanks. Directly behind is a pipe line station, and in the background is the company's camp. The illustration also shows the interesting manner in

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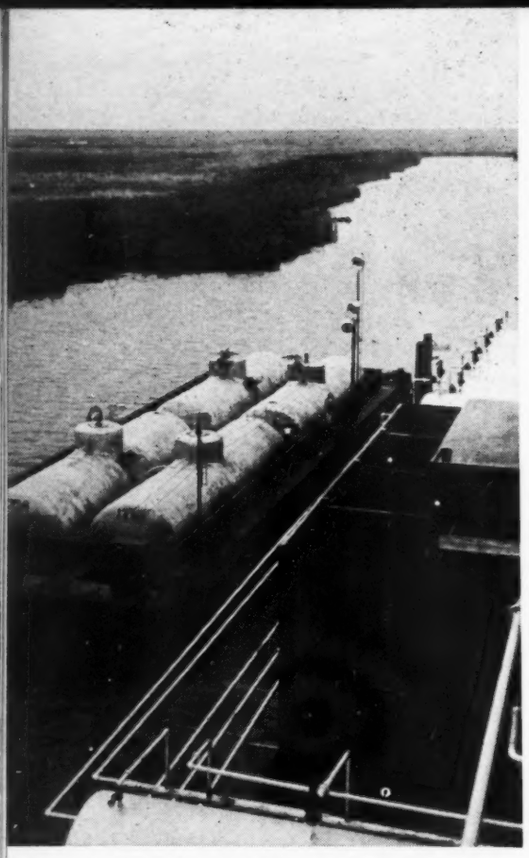


This special barge is used to transport the gasoline to a terminal at Avondale, Louisiana

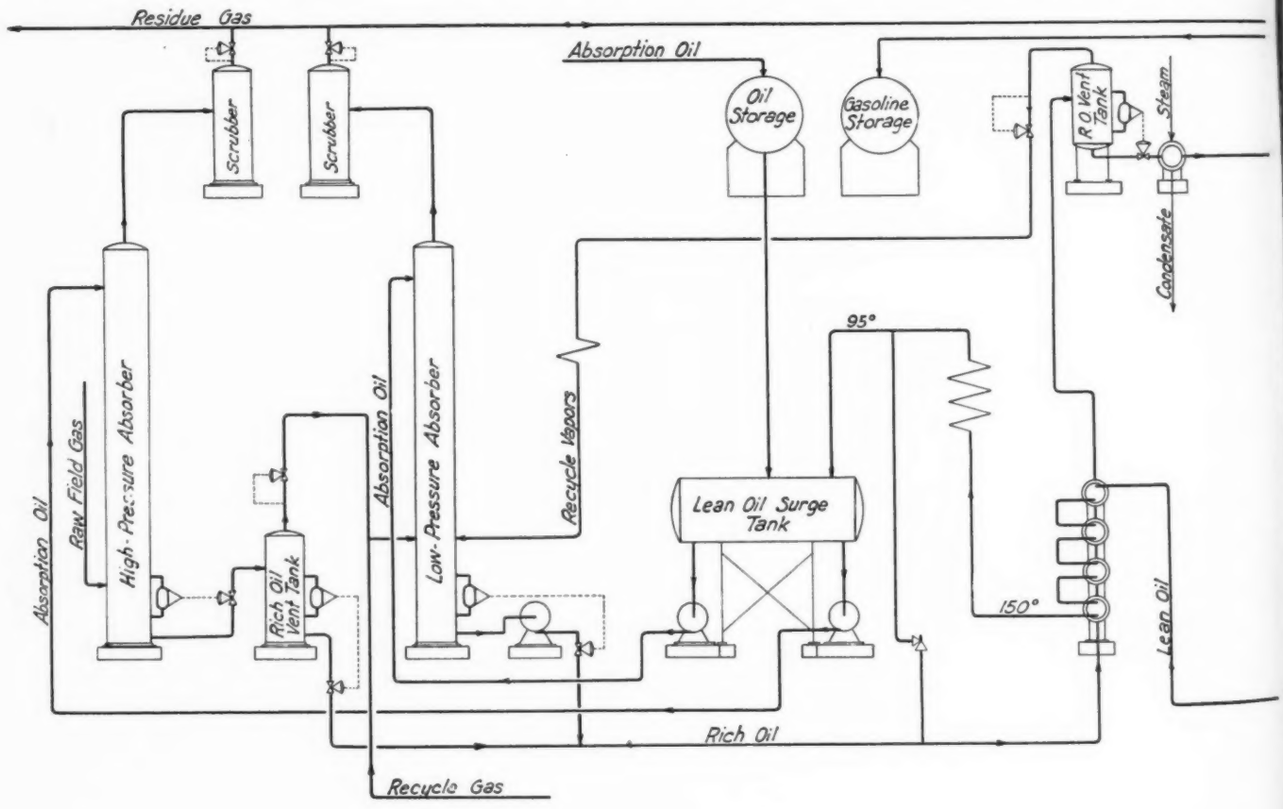
which the walkways connect the various units.

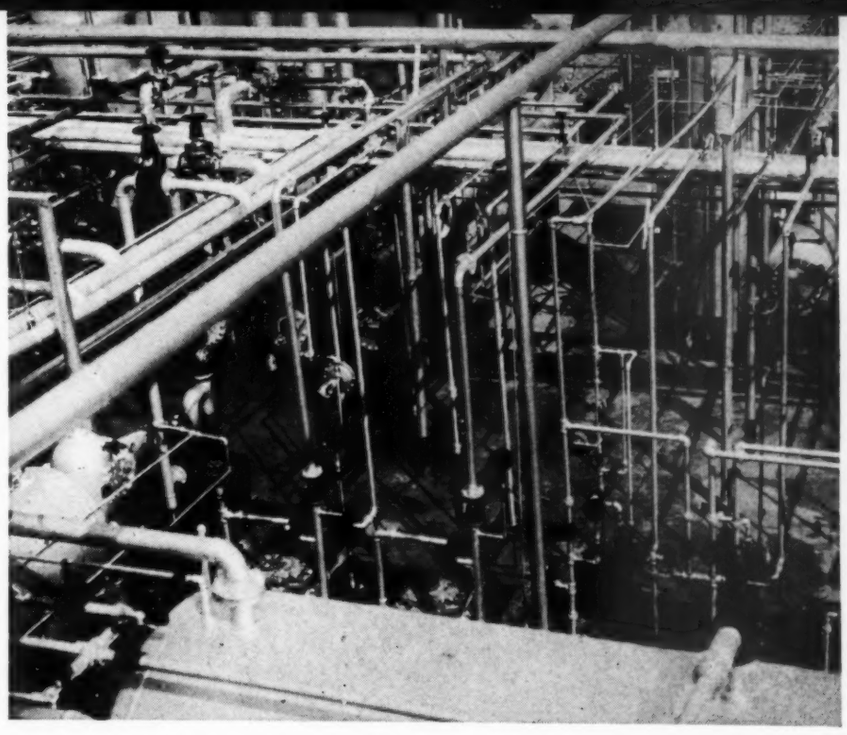
Operation of the gasoline plant, except in certain respects occasioned by local conditions, is not greatly different from that of a regulation plant. It is a two-pressure unit of the absorption type. The high-pressure side has a capacity of 15,000,000 cu. ft. of gas daily, and the low-pressure side a capacity of 3,000,000 cu. feet. The former operates at a pressure of 500 lb. and the latter at 25 pounds.

On each of the four leases, which comprise the Lafitte field, is situated a battery consisting of four high-pressure and four low-pressure separators, and four lease tanks each of 1000-bbl. capacity. Oil from the well-head is received through 3-in. lead lines by the high-pressure separators and gas taken off at a pressure of 500 lb., after which the oil goes to the low-pressure separators and additional gas removed at a pressure of 25 lb., the oil then being discharged to the tank battery. From these separators the high-pressure gas is taken to the plant where it first is passed through a mist extractor for removal of water, etc., then is sent to the high-pressure absorber, 42 in. in diameter by 32 ft. high. The low-pressure gas is passed through scrubbers and into the low-pressure absorber, 36 in. in diameter by 32 ft. high. Upon leaving the absorbers the high-pressure gas enters an 8-in. line extending approximately 25 miles to the south, being used for industrial consumption. The low-pressure gas is utilized on company leases.

In the absorbers the gasoline content of the gas is entrained with the absorption oil. Oil from the high-pressure absorbers leaves under its own pressure, but from the low-pressure unit it must be pumped. The two streams are consolidated upon leaving their respective absorbers, the whole passing through heat exchangers and entering a 42-in. diameter by 41-ft. high fractionating still where the gasoline is removed from the oil. This unit is operated at a pressure of 50 pounds. The stripped oil returns through heat exchangers and cooling coils to a surge tank, from where it is recirculated to the absorbers. Vapors from the fractionating still are sent through condensing coils, the gasoline going to a surge tank. A part of the condensate is recirculated to the still as reflux, the remainder being pumped to the stabilizing column. The latter is 24 in. in diameter by 50 ft. high and is operated at a pressure varying from 100 lb. to 250 lb., depending upon the grade of gasoline being manufactured. Here it is stabilized to specifications. At the present time the commercial grade of natural gasoline being made is 26-lb. Reid vapor-pressure. In addition a 9-lb. vapor-pressure motor fuel is manufactured, which is being distributed to the company's main warehouse at Houma and the various domes throughout the South Louisiana area for use as a fuel in all company marine equipment.

Flow sheet of Lafitte gasoline





An unusual view of the exhaust steam and oil piping

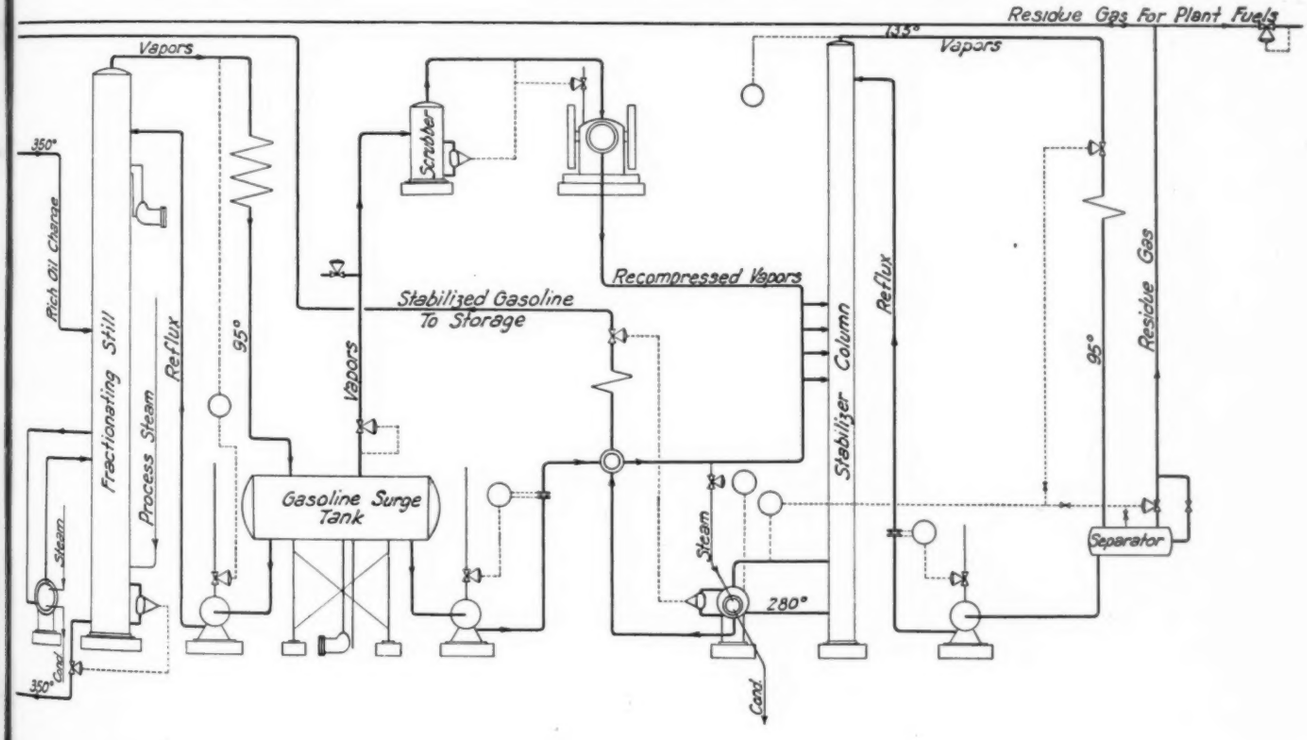
One of the features of the plant is the method of handling steam. Due to the fact that process water must be brought in on barges from Harvey, Louisiana, a distance of 40 miles, it is essential that every effort be made for its conservation. As a result all exhaust steam is condensed and returned to the steam plant. All process steam (generated at a pressure of 180 lb.) is trapped off the heating coils and returned to a high-pressure accumulator tank, held at a pressure of approximately 150 lb., and the condensate is pumped continuously to the boilers, the pump being under control of a float valve on the tank. Exhaust steam from the pumps and compressor is lead through a 6-in. line to condensers mounted above a low-pressure condensate tank. Incidentally, the compressor mentioned here is a 10 by 14 by 10 steam-driven unit used in handling wild vapors. Vapors from the gasoline surge tank, those released when loading the gasoline barge, and those from lease stock tanks and gun barrels are picked up by this equipment and boosted to the low-pressure absorber.

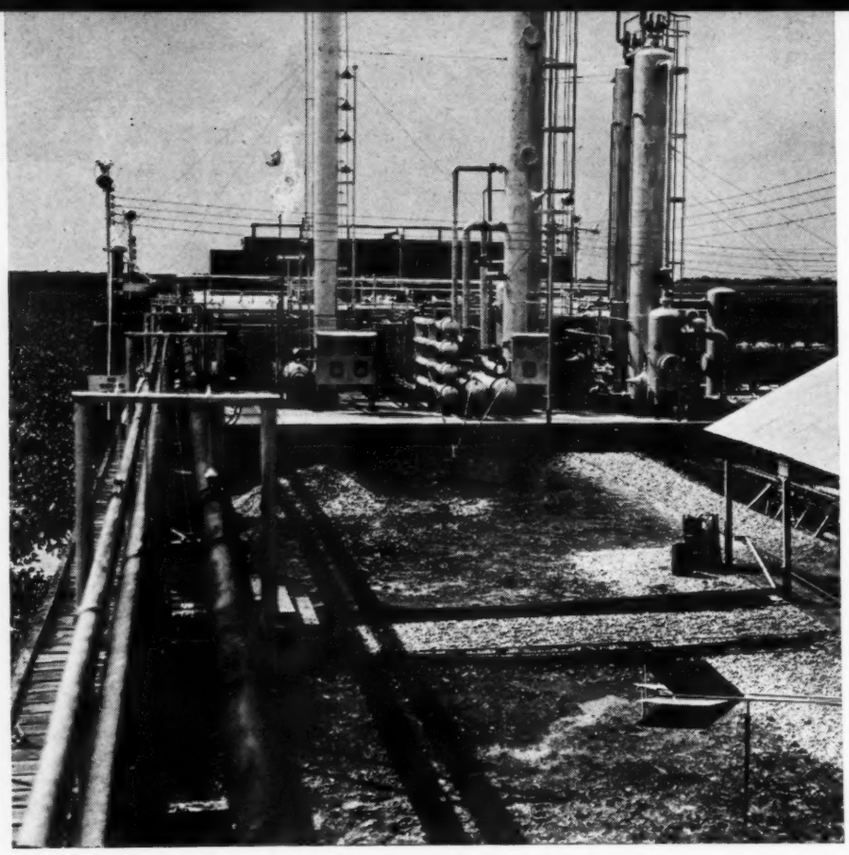
Four 125-hp. boilers generate process steam and are under control of fuel governors to make the operation as nearly automatic as possible. In the same boiler house are two additional 125-hp. boilers to provide steam for lease requirements. Makeup water is added to the supply tank through a float-control valve, so as to maintain a constant level, and water is pumped from the tank to the boilers, the delivery being controlled by regulators.

Cooling water is taken from the canals, consequently is plentiful and care need not be exercised in its conservation. This water is slightly brackish but is quite suitable for the purpose. Its temperature is even, in the summer seldom exceeding 80 deg. fahrenheit. All cooling coils are of the open type and are situated in a cooling tower; rather the base of a tower with the upper louvers eliminated. In this instance the louvers are not needed as the water is cooled by directing it back into the canal after it has passed over the cooling coils and flowing it to the opposite side of the island. This distance of approximately 800 ft. is sufficient to cool the water properly. Four centrifugal pumps circulate the cooling water.

Finished gasoline is pumped to storage, total capacity of which is 80,000

plant of The Texas Company





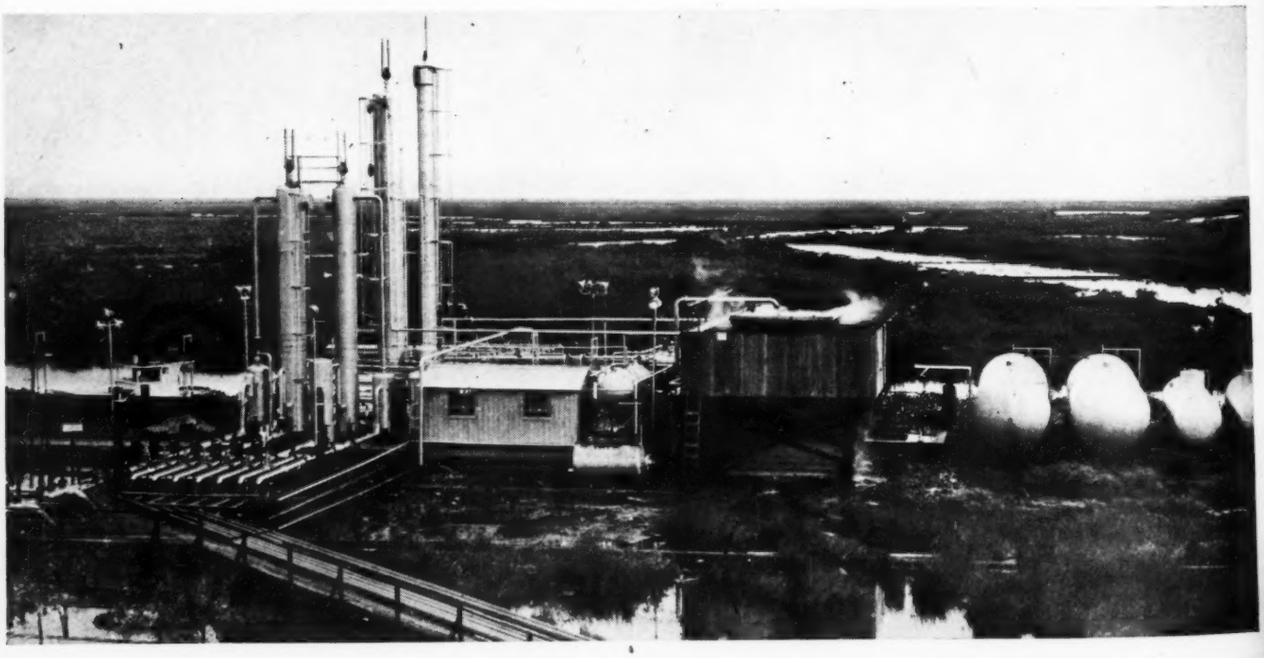
View of processing equipment. Also shown are the elevated flood lights, and the manner in which the columns are guyed as protection against strong winds

gallons. As there is danger of the storage tanks floating away should they be empty during high water, they have been anchored to their piling foundations by wire lines and turnbuckles. The commercial gasoline is transported by barge to a terminal at Avondale where it is blended into motor fuel. A special barge, 24 ft. wide by 82 ft. long by 5 ft. 6 in. deep, was designed and built for this purpose. It is of all-steel construction and was built according to Department of Commerce regulations. The barge contains four tanks, each having a capacity of 8000 gal., shown in one of the accompanying illustrations. To prevent pressures and temperatures from rising the tanks are insulated with spun glass. Aboard the barge is a steam-driven unloading pump. The entire equipment embodies all safety features required by the Department of Commerce, including special gauging equipment that permits gauging the tanks under pressure before unloading. When the gasoline is unloaded it is pumped from the bottom of the tanks.

The locale of the plant also necessitates employment of certain precautions other than those already mentioned. Fishing is a means of livelihood to a large portion of the inhabitants of this section of Louisiana and it is quite essential that contamination of waters be avoided. Consequently the concrete floor upon which the processing equipment is situated has a 4-in. curb completely around it. Drains also are provided and all oil, water, etc., that may be released drain to a tank beneath the floor. From there it is blown to lease tanks and the oil and water separated. The flat condition of the country, its marshy nature, and the strong winds that sometime blow up make necessary still another precaution. All processing columns must be guyed carefully, inasmuch as there is no foundation to hold them and when the wind starts blowing there are no hills or trees to slacken its velocity.

An office building, laboratory, and workshop for repairing meters, instruments, etc., complete the plant's facilities.

Meter platform on the left, the processing equipment, the cooling tower base (no louvers being used), and storage tanks. Also shown are walkways carrying the 6-in. lines



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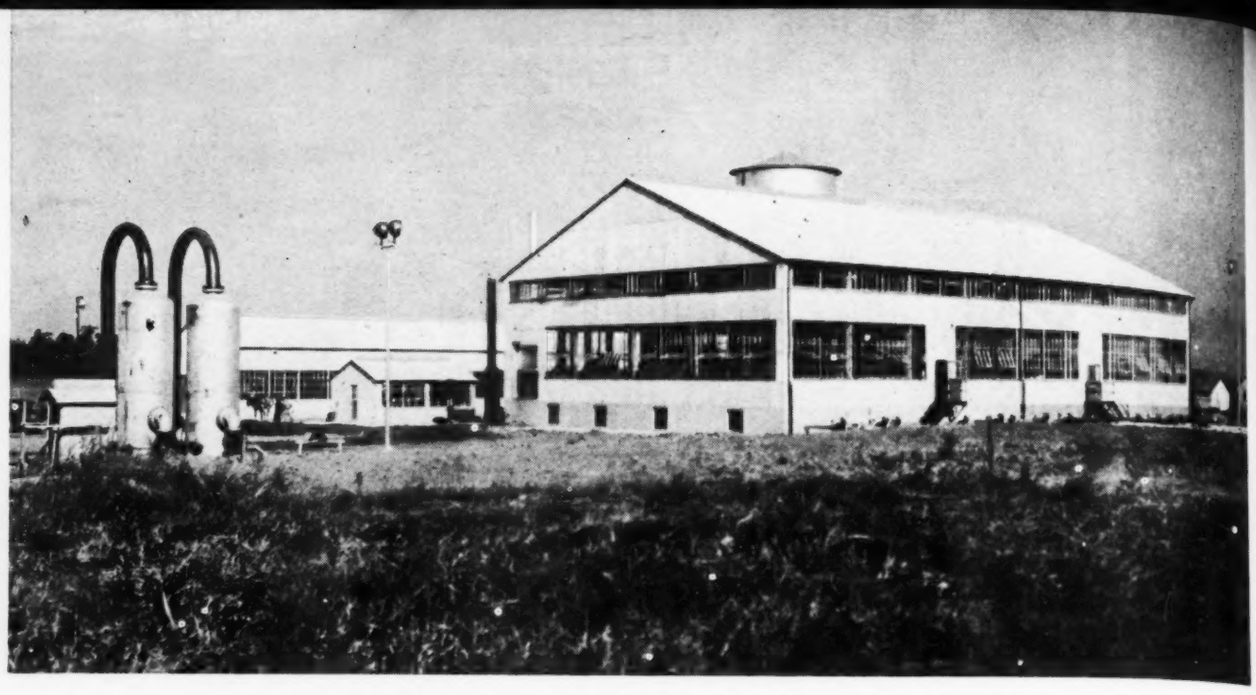


Montezuma Compressor Station of Michigan Gas Transmission Corporation

Installations Increase Capacity of Northern Gas Line

Construction of new compressor station, enlargement of another, and laying of new lines included in construction program of Michigan Gas Transmission Corporation now completed

By L. E. INGHAM, Superintendent of Transmission, Michigan Gas Transmission Corporation

WITH the advent of cold weather, construction work for the season of 1937 on the property of the Michigan Gas Transmission Corporation, a subsidiary of the Columbia Gas and Electric Corporation, has been completed.

The Michigan Gas Transmission Corporation obtains its gas supply from the Panhandle Eastern Pipe Line Company at the Illinois-Indiana state line and its principal point of delivery is Detroit, Michigan, numerous cities and small communities in Indiana also being served.

Early in the year, the prospects for increased deliveries at Detroit, as well as the procuring of contracts for delivery of gas to the Public Service Company of Indiana, The Northern Indiana Public Service Company, and the Kokomo Gas and Fuel Company, made it necessary to install additional equipment to handle the increased load.

At the compressor station near Montezuma, Indiana, two 24-in. by 36-in. Worthington twin gas engines, direct-connected to 15-in. by 36-in. compressors were installed, thus doubling the capacity of the station, and making a total of 5200 hp. installed.

While this work was under way, a new compressor station was constructed near Zionsville, Indiana. Here, four 24-in. by 36-in. Worthington twin gas engines, direct-connected to 13⅛-in. by 36-in. compressors were installed, together with the auxiliary machinery, cooling towers, water tank, water wells, etc.

At this point, two residences were erected, one for the chief engineer of the compressor station and the other for the pipe line superintendent, whose headquarters are on the Zionsville property.

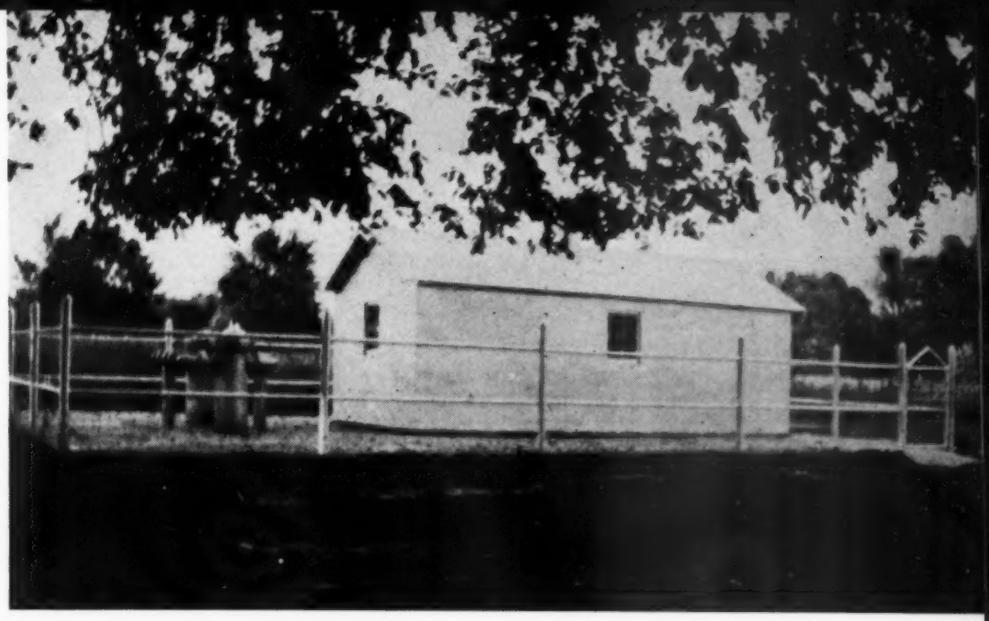
The Zionsville Station is situated approximately 60 miles east of the Montezuma Station at the point where the 22-in. line of the Michigan Gas Transmission Corporation connects into its 20-in. line running from Illinois to Muncie.

The Fluor Corporation of Los Angeles, California, was awarded the contracts for both of the above-mentioned projects. In addition to the main units, the Worthington company also supplied the vertical gas engines for driving the electric generators. The Chicago Bridge and Iron Works supplied the elevated water tank and the Fluor Corporation provided their own make of cooling towers and also their heating system, which is connected with the exhaust manifold from the main engines for heating the compressor building. A Permutit water softener was installed, and a Kewanee boiler was put in to heat the auxiliary power house, as well as the main building, at times during cold weather when the compressors are shut down.

Construction work on both compressor stations was started late in April. The work at Montezuma was completed in August, and the work at Zionsville was finished November 1.

Late in April, a connection was made to the Michigan Gas Trans-

(Continued on Page 81)



Town border measuring station with gas cleaners outside of building

(Continued from Page 78)

mission Corporation's 22-in. Detroit line to supply the towns of Noblesville and Tipton, Indiana, which are served by the Public Service Company of Indiana. After completion of the Noblesville connection, a 4-in. line approximately 13½ miles long was laid from a point on the 20-in. line near Brownsburg to Lebanon, Indiana, where it was connected into the line of the Public Service Company of Indiana to supply Lebanon, Frankfort, and other communities in that vicinity.

While the line to Lebanon was still under construction a 6-in. line was being built to Crawfordsville, Indiana, from a point on the 20-in. Michigan Gas Transmission Corporation's line near Roachdale, Indiana. This 6-in. line is approximately 19 miles long and connects with the lines of the Public Service Company of Indiana at Crawfordsville to supply Lafayette, Attica, Williamsport, and Crawfordsville, as well as many small communities between those towns.

All of the construction work outlined was completed before July 1, and upon completion of each line natural gas service was started in the various cities served by that line.

Early this fall, a 6-in. line approximately 13½ miles in length was constructed from the 22-in. Detroit line at a point near Decatur, Indiana, to Fort Wayne, Indiana, and gas was turned into the lines of the Northern Indiana Public Service Company at Fort Wayne on October 22.

During the period of construction of the line to Fort Wayne, connections were made from the 22-in. Detroit line to the lines of the Northern Indiana Public Service Company near Bluffton and Decatur, Indiana, and gas was first supplied to those towns early in October.

Coincidently with the construction of the Fort Wayne line, a 6-in. line approximately 11½ miles long was laid from a point on the 22-in. Detroit line near Aroma to Tipton, Indiana, where it was tied into the line of the Kokomo Gas and Fuel Company. This line was completed November 5 and gas turned into the lines of the Kokomo company on that date.

The territory through which the lines to Fort Wayne and Tipton are laid is highly developed farmland, underlaid practically throughout the lengths of the lines with drain tile. These tiles, particularly on the line to Tipton, were running full of water, which necessitated the pipe-laying crew working directly behind the ditching machine. In addition to the water in the drain tile, eight large drainage ditches were crossed on the Tipton line. Fortunately the weather was exceptionally good during the construction of this line so the difficulties caused by water were overcome speedily.

All the lines were constructed of Grade B seamless line pipe, solid electric welded construction with all gate valves, fittings, etc., specified for 500-lb. working pressure.

Contracts for construction of all lines were awarded to the Bibb Contracting Company, who handled all construction work, including the welding, with their own organization, the only exception being the pipe stringing, which was sub-contracted to W. Hobson Dunn.

In connection with the other construction work, two high-pressure Blaw Knox gas cleaners were installed on the inlet side of Montezuma Compressor Station and a battery of three similar cleaners was erected at the inlet of the Detroit measuring station.

In order to measure the gas delivered at the various plants, measuring stations were designed and constructed by employees of the Michigan Gas Transmission Corporation. The smaller stations made use of high-pressure positive meters installed in multiple settings with regulators installed to deliver gas at pressures needed at each station. The larger stations consisted of multiple orifice meter settings having automatic valves that cut the second meter in and out of service as gas deliveries required.

Exposition of Stainless Steel

AN exposition of stainless steel has opened for a period of several months in the New York Museum of Science and Industry, RCA Building, Rockefeller Center, New York City. This exhibit, which is sponsored jointly by Electro Metallurgical Company, Unit of Union Carbide and Carbon Corporation, New York, and the Museum, will be open every day from 10:00 a. m. to 10:00 p. m.

Every aspect of stainless steel—its history, development, production, fabrication, and uses—is portrayed in a comprehensive, interesting, and educational manner. The display includes hundreds of stainless steel products sent to the exhibit by manufacturers from all over the United States.

The displays of stainless steel products are supplemented by motion pictures and demonstrations showing why stainless steel is an important contribution to mankind.

An Important Announcement—

We take pleasure in announcing that, effective January 1st, 1938, THE PARKERSBURG RIG & REEL COMPANY becomes the exclusive distributor for SMITH SEPARATOR CORPORATION, Tulsa, Okla.

This arrangement is made in the belief that it will expedite and improve the service of both concerns on a line of equipment which has for many years contributed to the safe, efficient, economical operation of the oil industry.

In expressing our appreciation of your patronage in the past, these pioneer concerns solicit the privilege of serving you in the future.

THE PARKERSBURG RIG & REEL CO.

SMITH SEPARATOR CORPORATION

Gravel-Packing Oil Wells

The introduction of gravel between the perforated casing and the wall of the well reduces caving and clogging of perforations

Part 1

By

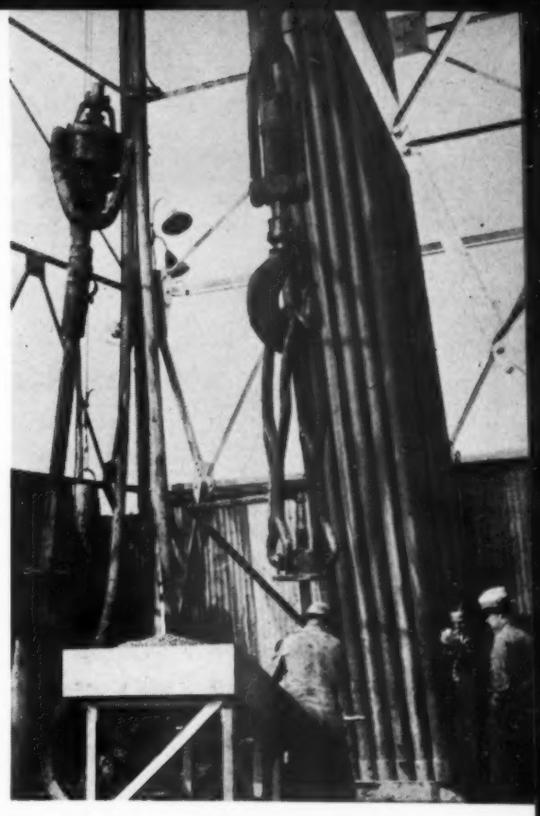
WALLACE A. SAWDON

Petroleum Engineer, Los Angeles, California

ALTHOUGH for approximately 40 years water wells have been gravel-packed to increase production, the application of the gravel-packing principle to oil wells was not made until six or seven years ago. During the last year, however, serious attention has been given to the possibilities of placing a gravel wall around the oil string or liner in oil wells in California as a means of eliminating sand trouble where the producing formations are known to cause trouble from excessive sanding or sloughing. The chief reasons for the use of gravel-packing in such wells have been to reduce to a minimum the infiltration of sand into the hole and to protect the walls of the well during its producing life. Sufficient time has not elapsed for the wells completed and repaired with gravel-packing to provide data on the effect over an extensive period; however, the immediate results obtained have indicated clearly that if the job is properly performed, considerably less time is spent on each clean-out job, that the intervals between jobs are much longer, and that shut-down time is very materially reduced. Moreover, there is almost certain to be an increase in well production due to the larger hole made for the placement of the gravel, although no records have yet been made available to prove conclusively that such increased production has been obtained.

All companies having experience in gravel-packing in California feel definitely that the work done so far has been more or less experimental. Because results indicate the value of gravel-packing under certain conditions, however, greater attention is being given to determination of the best subsurface equipment to use and the method of gravel placement that will be most economical and effective.

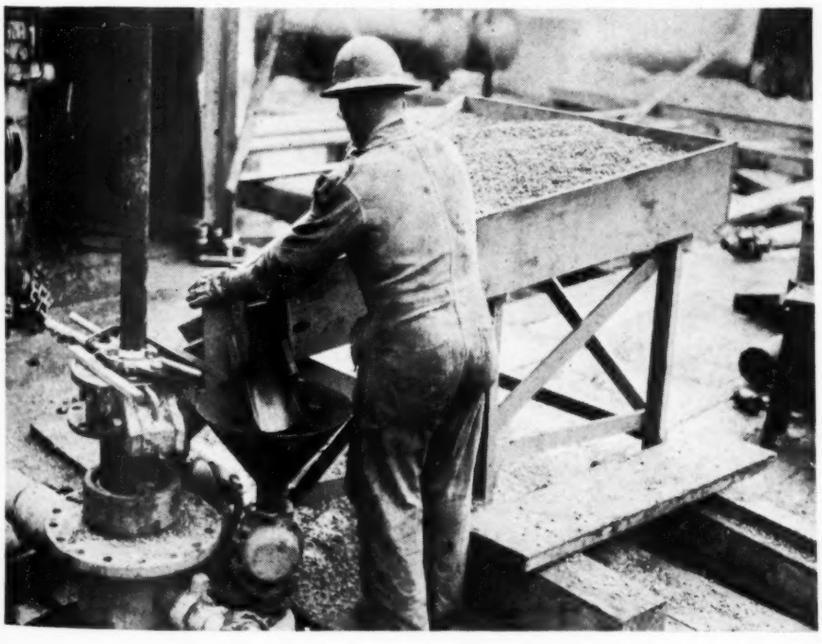
The subsurface equipment consists of a slotted or perforated liner or screen of carefully determined size, and the gravel, which must meet the requirements imposed by the sand grains and the openings of the liner.



Gravel-packing a well in the Wilmington field, California. Note the tubing supported by the elevator and the return line leading off from the top

Methods of placing the gravel around the pipe vary in detail and in general principle. These methods are here discussed under the classification of: (1) Reverse Circulation Method, in which the gravel is injected between the casing and tubing on which the liner is run and through which fluid returns to the surface; and (2) Normal Circulation Method, in which the gravel is pumped down inside the tubing, the fluid returning between the tubing and casing. Any method applied will have to conform to the subsurface conditions encountered and to the type of equipment used to produce the oil.

Practically all recent gravel-packing jobs have been new well completions. The use of gravel around the liner through the producing zone in recompleting or repairing old wells has been employed to some extent in California and elsewhere. It has seemed to be especially applicable where cavities have formed during flowing or gas-lift operation, loosely consolidated sand having been carried into the hole. Such wells may have sufficient enlargement



The gravel is allowed to flow into the lubricator through the funnel and when one lubricator is full the process is repeated on the other side to fill the other lubricator. Continuous flow of gravel down the well thus is obtained.

through most of the sand thickness to provide space for all the gravel necessary for packing around the liner; yet there must be assurance that the entire distance through the sand is properly enlarged, and wall scraping may be necessary. In most recompletion work the hole has to be scraped in the same manner as a new well.

Enlargement of Hole

The diameter of the hole through the producing zone enlarged to provide the necessary thickness of gravel between the wall and the liner, naturally is influenced by the size of liner or oil string used. This annular space outside the liner also must be large enough to permit free passageway for the gravel without bridging at any point up the hole. When it is considered that the space between the liner and the casing in which it is set will almost invariably be smaller than any enlarged portion below the shoe of the casing, the bottleneck between liner and casing assumes special importance when the gravel is injected by reverse circulation.

This restricted area between the liner and the casing probably presents the greatest bridging hazard in gravel-packing with reverse circulation. In one well the gravel bridged there and, when the tubing was pulled up a short distance, the sleeve used to keep the gravel out of the liner was raised. This allowed gravel to get between the liner and the tubing and froze the latter. The largest practical water string and smallest liner should be used and a 6⅝-in. liner should not be contemplated if the water string is smaller than 11¾ in. in diameter.

The 11¾-in. casing allows wall scraping to any desired diameter and eliminates dangers involved in trying to cut the walls too far with a small wall scraper. If the gravel is put down through tubing, the space between the casing and the liner is of less importance, as it need pass only the carrying fluid after the gravel has dropped out.

It is the practice in California to enlarge the hole below the water string with a wall scraper. The amount of wall cut away, however, appears to be governed by the experience of the operator. At first there was a tendency to make the hole as large as possible and thus provide a gravel-packing of maximum thickness. The purpose of the gravel is to entrap in the interstices of the gravel any sand flowing out with the oil. This may be accomplished within a very short distance from the face of the wall if the gravel is of the proper size. As greater study is given to the relation between the

(Continued on Page 86)

PIONEERS

6 YEARS AGO—HOLE ENLARGING

BAKER ROTARY WALL SCRAPER
(Same Body as Baker Wall Sampler)

BAKER WALL SCRAPERS have been used for Gravel Packing since this method was first introduced six years or more ago as an important development in completing and repairing water wells—and subsequently in oil wells. In fact, in 1931, the Baker No. 8 Wall Scraper, which has an expansion of 36 inches, was developed especially for preparing water wells, and soon after oil wells, for Gravel Packing, and has since proved the ideal tool for this purpose.

HERE ARE A FEW OF ITS MANY USES
in addition to gravel packing . . .

- You can bring in a well easily and in less time by scraping all rotary mud from the face of the oil sand.
- Scrape a wide shoulder as the first step in bringing a crooked hole back to vertical.
- Enlarge the hole to set a larger size liner without having to turn down any couplings.
- Bottleneck the hole above the shoe to insure a water shut-off when cementing casing.
- Obtain a better bond of cement by wall scraping away rotary mud and exposing original formation.
- When bottom water shut-off fails, wall scrape to size of original hole, or larger (after drilling out old cement) . . . then recement.

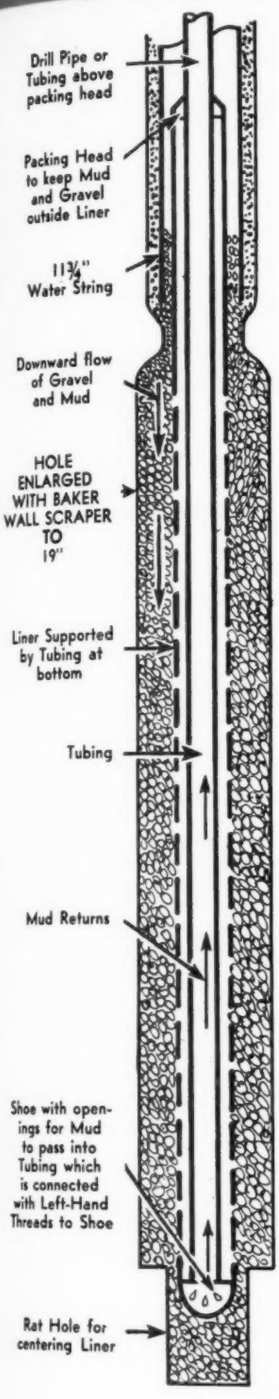
SAFETY FIRST . . . The Safety of the Baker Wall Scraper has been demonstrated in thousands of successful runs made in oil fields throughout the world under the most difficult operating conditions. To our knowledge, no Baker Wall Scraper has ever failed to come safely out of the hole.

AMAZING REAMING CAPACITY . . . One of the outstanding features of this remarkable tool is its amazing reaming capacity. It has a reaming expansion range of from 4 inches to 36 inches, by using only six Wall Scraper Bodies. Tremendous strength, combined with minimum overall dimensions, make it possible to run the tool through casing of comparatively small diameter, then to expand the blades and scrape the open hole below the casing from a minimum to an amazing diameter.

For Complete Details Concerning the Design, Construction and Operation of the Baker Wall Scraper and Wall Sampler . . .
See the BAKER SECTION of Your COMPOSITE CATALOG.

BAKER

FOR... GRAVEL PACKING


Drill Pipe or Tubing above packing head
Packing Head to keep Mud and Gravel outside Liner
11¾" Water String
Downward flow of Gravel and Mud
HOLE ENLARGED WITH BAKER WALL SCRAPER TO 19"
Liner Supported by Tubing at bottom
Tubing
Mud Returns
Shoe with openings for Mud to pass into Tubing which is connected with Left-Hand Threads to Shoe
Rat Hole for centering Liner

ONE OF THE most important developments in modern well completion and well repair work is the placing of a gravel packing around the liner and through the producing oil zone. Its application is particularly advantageous where formations are likely to produce sand with the oil, or where the walls of the hole have a tendency to cave.

Gravel packing accomplishes two important results: First, it minimizes sanding up of the well, and, second, by the very fact that it ***does*** minimize sanding, it reduces well cleaning costs by reducing the number of cleanout jobs and the actual time spent on each.

To accomplish a gravel packing job it is necessary to enlarge the hole below the water string for a distance extending through the drainage area. To insure the hole being enlarged to a sufficient diameter to permit the necessary amount of gravel to be placed around the liner, it is important that the tool used to enlarge the hole be capable of sufficient expansion to make this enlargement.

Modern operators prefer a Baker Wall Scraper to do a gravel packing job because of its amazing expansion range, plus its operating safety and efficiency, (described on opposite page).

The accompanying illustration shows a typical gravel packing job. It will be noted that the hole below the water string has been enlarged with a Baker Wall Scraper to a diameter of 19 inches. The original hole was drilled to bottom to provide a rat hole for centering the slotted liner. In this operation the gravel was pumped down the hole in the annular space between the water string and the formation. The result is that the gravel accumulates in the enlarged diameter between the liner and the wall of the hole, and the circulating fluid, passes through the shoe at the bottom of the liner, returning to the surface through the tubing.

While the above is only one of several types of gravel packing jobs, it is typical of the part that a Baker Wall Scraper plays in accomplishing this important well completion and well repairing operation.

BAKER ROTARY WALL SAMPLER
(Same Body as Baker Wall Scraper)

BAKER ROTARY WALL SAMPLER

By the simple procedure of substituting Wall Sampler Blades, with core taking tubes, for the regular Wall Scraper Blades (done in only 4 minutes) it is possible to take actual cores from the side walls of any uncased hole (excepting perhaps where the formation is extremely hard) at any depth.

Thus the Baker Wall Sampler makes it possible to secure true samples of the formation from which cores were not taken, were lost or were incomplete. Each set of Wall Sampler Blades contains four small core-taking tubes approximately ½" inside diameter and 2" in length. These blades have no cutting edge but serve only to protect the tubes and to guide them into the formation.

BAKER OIL TOOLS, INC.

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ROTARY WALL SCRAPER
ROTARY WALL SAMPLER

Although clean gravel is delivered for the job, it is screened just before being put into the well

(Continued from Page 84)

size of the gravel and the size of the sand grains of which the producing zone is composed, it may be found that the thickness of the gravel-pack can be reduced considerably.

The largest diameter provided for a 6⅝-in. liner in the wells studied by the writer was only 16 inches. This well is in the Wilmington field and was completed as a flowing well. In the first well gravel-packed by one company in a San Joaquin Valley field, a 10⅝-in. hole was enlarged to 20-in. diameter. Using 6⅝-in. liner, however, it would appear that wall-scraping the hole to 16 in. would be sufficient and that even a smaller enlargement might be just as effective were the gravel properly selected. Future results, however, may indicate an advantage accruing from increased production from a larger hole that might make it desirable to scrape to a larger diameter than is actually required for effective gravel-packing. The thicker gravel-pack probably is not harmful unless it is not placed to form a lasting fill between the liner and the wall of the hole. The thicker pack will be more expensive and establishment of a stable mass around the pipe may not be as readily assured.

The size and kind of openings in the liner must be given careful consideration. Slotted pipe seems to be most favored for gravel-packing at the present time but developments in the methods used, the size and kind of gravel selected, and a better determination of the relation between the gravel and the formation sand may influence the size and kind of openings to a great extent. Some interesting data on the behavior of sand grains are given in "Selection of Screen Openings for Unconsolidated Sands," by C. J. Coberly[1], and the results of his experiments have a direct bearing on providing proper openings in liners for gravel-packing. This is especially true with regard to the finer gravel used for placement through tubing. Gravel will bridge openings that are larger than the gravel grains themselves. With this fact more generally recognized the tendency later may be to use either larger openings in the liner or, more probably, smaller size gravel.

(EDITOR'S NOTE: Part II, concluding this article, will appear in the January issue.)

[1]Paper read at 18th Annual Meeting, American Petroleum Institute, Chicago, November, 1937, and abstracted in *The Petroleum Engineer*, November, 1937.

Tests Made of Anti-Knock Qualities of Motor Fuels

SO THAT laboratory results of experiments conducted by the Research and Development Department of The Atlantic Refining Company might be augmented by tests conducted under actual road conditions, a highway laboratory was operated during the summer months near Lewistown, Pennsylvania, for the purpose of testing the anti-knock qualities of motor fuels.

Ten cars, representing the major portion of those in general use, were driven over a measured course under conditions ranging from mild to the most severe encountered in city and cross-country driving. Each car carried a driver and a trained observer who noted the performance of the gasolines under test. Test fuels were matched against reference fuels standardized in the research laboratory, thus providing a comprehensive road rating of each fuel in terms of octane numbers.

A total of 112 fuels, representing a wide variety of crudes and methods of refining, were tested during the experimental period. Approximately 1500 octane ratings were made. The accumulated data is expected to prove of outstanding value to refinery engineers in their constant quest for more efficient methods of refining gasoline to produce motor fuels of still higher quality.

Ten test cars, all current models of leading manufacturers, were used by The Atlantic Refining Company during the tests conducted on Sand Mountain near Lewistown, Pennsylvania. An engineer is shown checking the motor of one of the cars before permitting it to traverse the test mile

Hitting the Bull's-Eye Two Miles Underground

AN interesting application of General Electric miniature instruments and other electrical equipment is their use in "Hitting the Bull's-eye Two Miles Underground" with the Lane-Wells Company's gun-perforator. The gun-perforator is an ingenious tool that has been developed to perforate oil-well casings by firing

Operator makes a shot with the gun-perforator

steel bullets through them instead of using mechanical perforators as was the practice in the past. With this new method, it is possible to perforate the casing exactly at the point desired and to perforate several strings of cemented casing if necessary.

When a casing is to be perforated, a "gun," which consists of several loaded firing chambers mounted in a cylinder so as to fire at right angles to the cylinder, is lowered into the well with conductor-core cable until it reaches the level where perforation is desired. The charges are then fired electrically, one after another, by a firing controller, situated in the head of the gun. Contact for each shot is made by closing a switch in the service truck at the surface.

To facilitate handling of the perforating equipment at the well and to move it rapidly from job to job, the Lane-Wells Company has equipped 25 trucks with complete apparatus for handling this work and ten more are under construction. Each truck has an engine-driven cable drum that carries 8000 ft. to 13,500 ft. of General Electric conductor cable, and engine-driven generators to supply both a-c. and d-c., and an instrument panel. Included on the panel are General Electric instruments for determining electrical conditions in each circuit, and electrical weight and depth indicators. From this panel the operator may keep himself informed of the exact condition of his work at all times and may check any part of his equipment when necessary. For instance, one of the d-c. instruments provides the operator with a check on the actual occurrence of each shot, no matter how deep in the well the gun may be. These shots often are made at depths as great as two and a half miles. The gun must be located within the limit of one foot.

When it is remembered that the future production of a costly oil well depends upon the precise location of the gun and the infallibility of firing, the need for these factors becomes apparent. Electricity and correct measurement of it make such infallibility and precision possible.

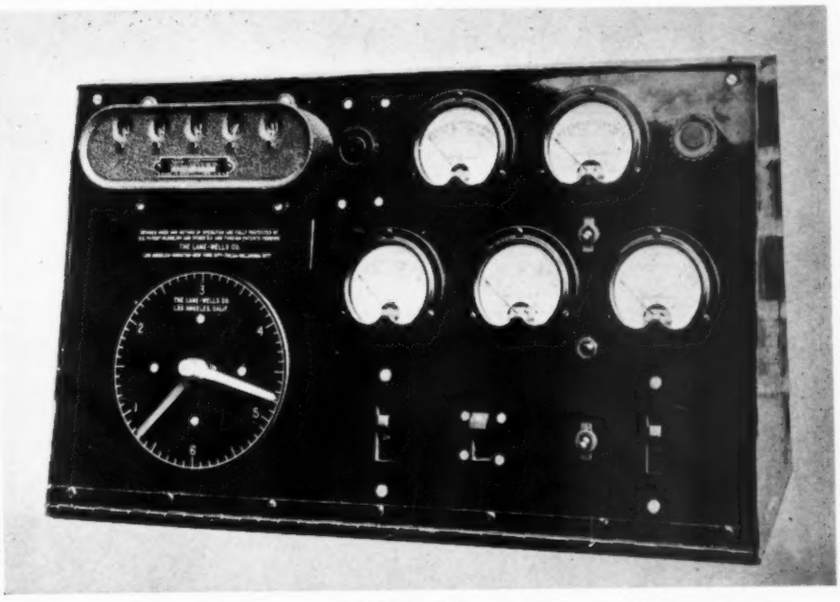
General Electric miniature instruments are used exclusively on the Lane-Wells gun-perforator trucks. The miniature type is employed to conserve panel space and because accuracy is retained in spite of the jar and vibration inflicted by travel over poor roads.

Other General Electric products used in "Hitting the Bull's-eye" are the Selsyn motors, which are the substance of the weight and depth indicators. These indicating devices depend on the synchronizing feature of the Selsyns for their accurate operation. So that the operator of the gun perforator knows at all times the depth the gun has been lowered into the well, one set of Selsyns is used for depth indication. The sheave over which the cable passes at the top of the well is geared to one motor so that the motor makes one complete revolution for each foot of cable that passes over the sheave. On the instrument panel, the mating motor is connected to a counter that registers directly the number of feet of cable that has been reeled out.

The weight indicator, so sensitive that the operator can tell when the gun strikes or leaves the fluid level in the well, also utilizes Selsyn motors. A calibrated compression spring is connected between the sheave over which the cable runs into the well and the sheave frame. Expansion or contraction of this spring is transmitted through a rack and pinion to a Selsyn unit. The mate to this unit, mounted on the back of the instrument panel, records the weight that is on the cable.

Use of the Selsyns in the depth and weight indicators makes possible the very accurate measurements that are necessary in the operation of the gun perforator. At all times the operator knows the depth of the gun within a few inches and the weight on the cable within a few pounds.

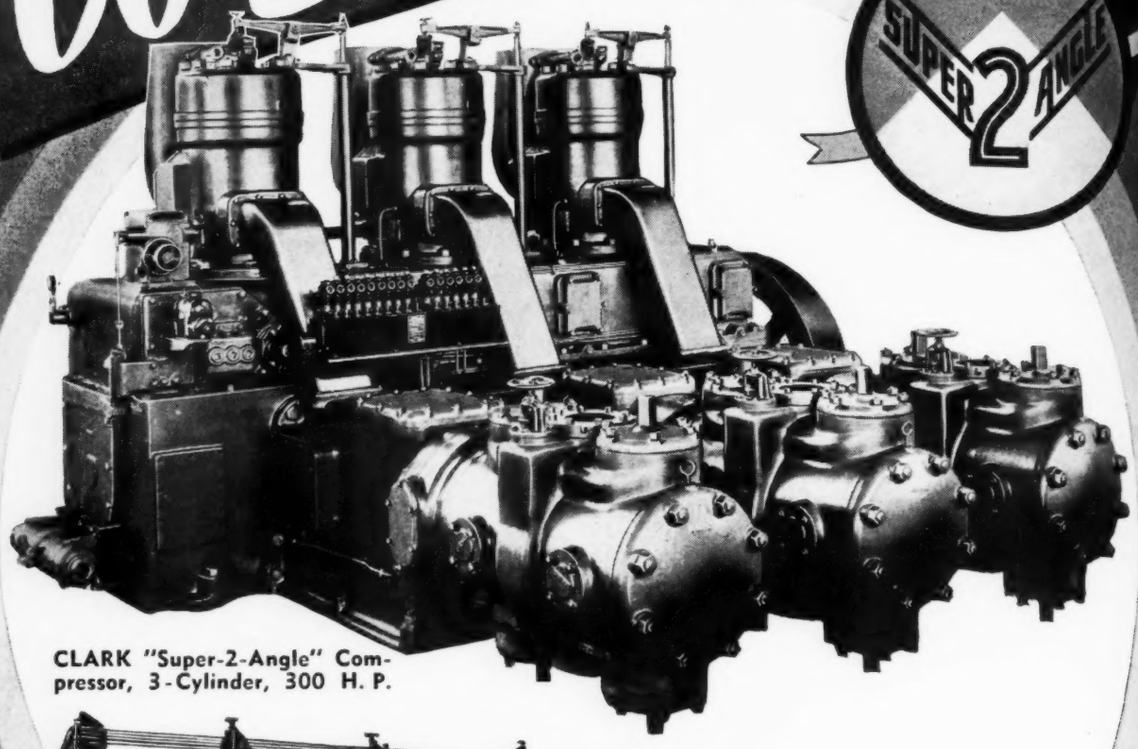
A specially concentrically compounded cable, providing a steel sheath for carrying the weight of the gun and an insulated copper core for carrying the firing current, is used to lower the gun into the well. As the cable is fabricated, it is treated with General Electric Glyptal to protect the core against any oil or moisture that might penetrate the steel sheath and against the extreme heat found in deep wells.



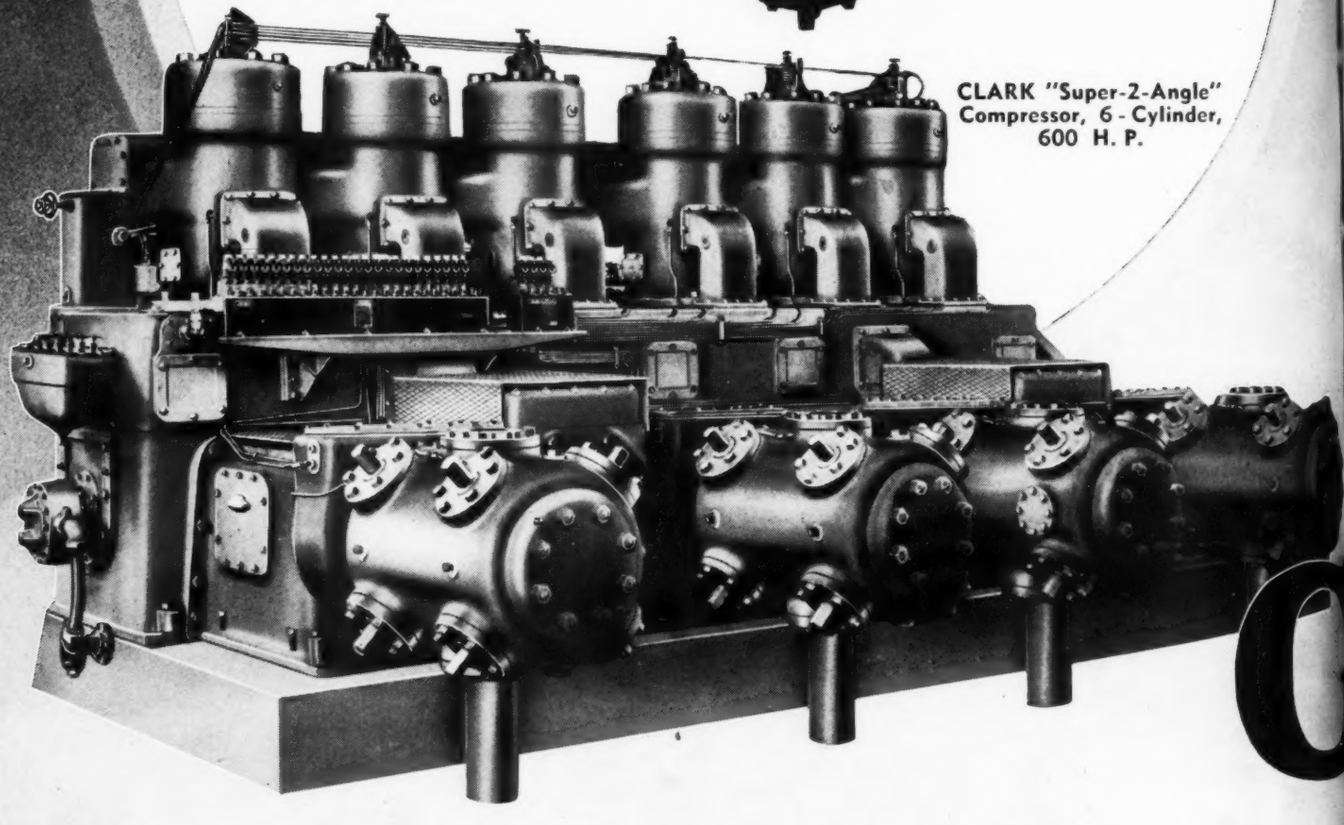
Instrument panel on Lane-Wells Company gun-perforator truck

a Sensational

SUPER 2 ANGLE



CLARK "Super-2-Angle" Compressor, 3-Cylinder, 300 H. P.



CLARK "Super-2-Angle" Compressor, 6-Cylinder, 600 H. P.

Success, Because—

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The CLARK "Super-2-Angle" Compressor has been one of the mechanical sensations of the past two years. Leading oil and gas companies, after thorough investigation, have invested hundreds of thousands of dollars in these new-type compressors. They are proving money-savers in Natural Gasoline Plants, Vapor-Recovery Plants, Re-Pressuring Plants, Gas Booster Stations, Oil Pipe Line Stations, Gas and Air-Lift Plants.

Their success is attributable to the 5 substantial savings they achieve. They

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5. HAVE LOWER MAINTENANCE EXPENSE, due to simplicity of design.

Other important advantages are: No exhaust or intake valves, 25% excess scavenging air, full force-feed lubrication. These compressors offer a real opportunity to save money. Full particulars on request. Also

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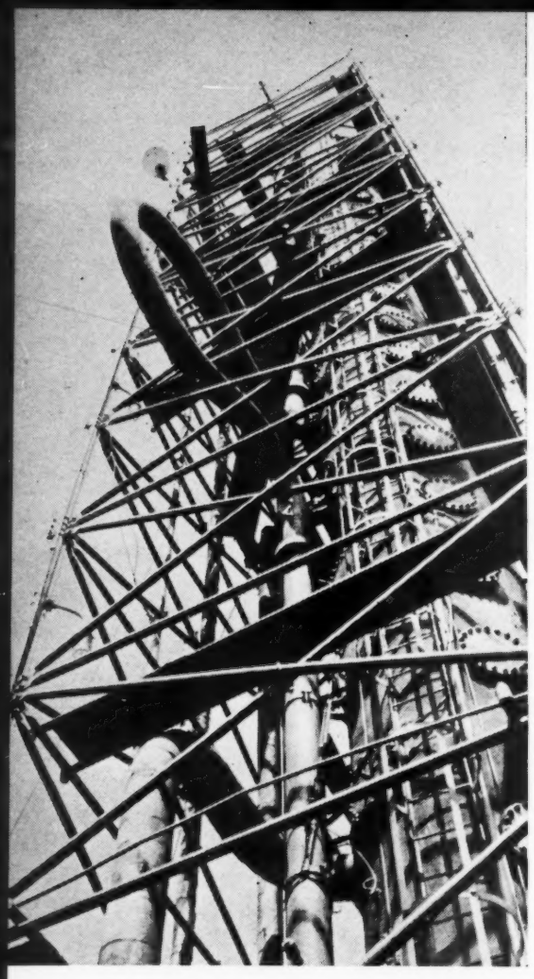
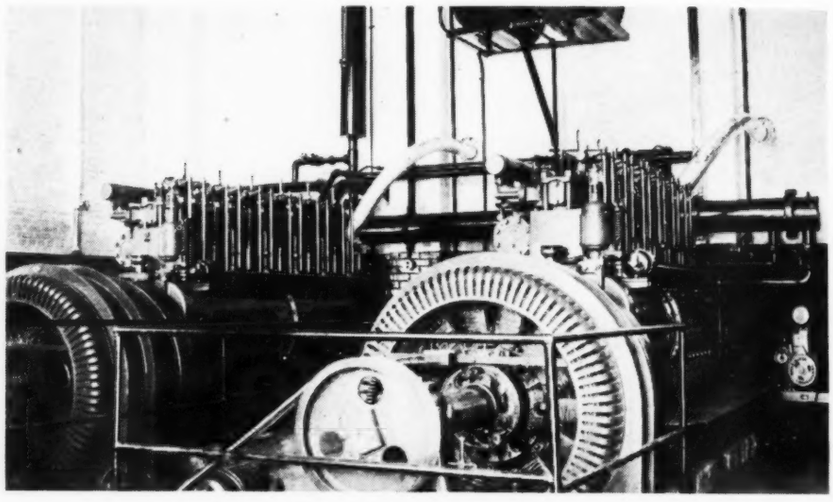


Michigan Refinery Remodeled to Produce Premium Grade Gasoline

"Double-flashing" supplants conventional refining methods

By J. C. ALBRIGHT

Above—One of the columns, showing the type of platform supports built into the unit



Right—Two 125-hp. Diesel engines coupled directly to 156-kva. generators

THE Roosevelt Oil Company changed the method of operation of its refinery at Mt. Pleasant, Michigan, during the fall and winter of 1936 to utilize the "double-flashing" method installed by its engineers, which requires two furnaces and two fractionating columns. Previous to this change, the plant was operated in the conventional manner, a single furnace and one fractionating column having been used to manufacture special naphthas and motor fuel. As Michigan crude is especially well fitted by nature for the processing of special naphthas, these products are made in quantities throughout the State, but gasoline for automobiles must have a very low end-point so the octane number will be sufficiently high for the gasoline to be marketed without blending with additives. Premium grades of gasoline, however, are prepared by ethyl fluid addition in the new plant of the Roosevelt Oil Company which was completed during the summer of 1937.

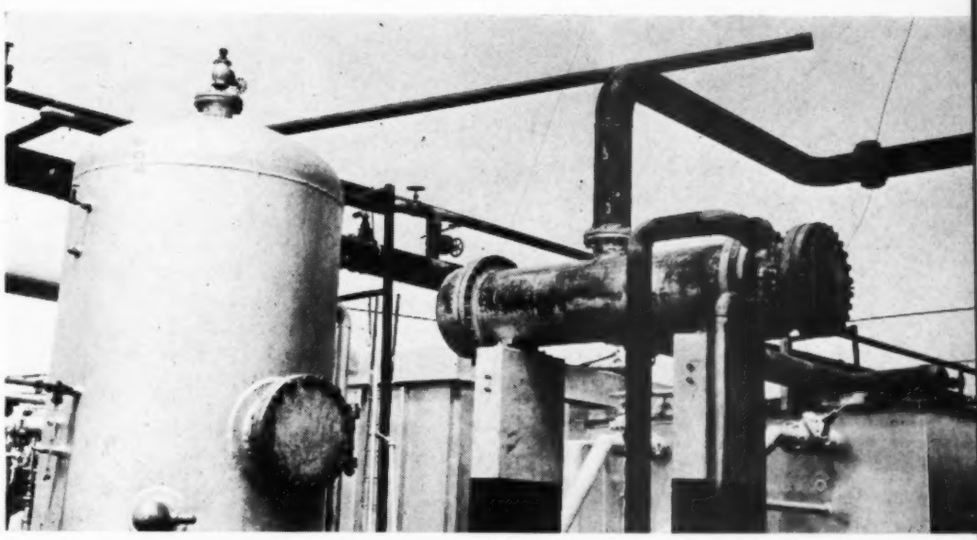
The crude obtained from the fields in Michigan varies considerably in gravity, the maximum being approximately 45 deg. A.P.I. in some new fields, such as Crystal when it was flush, but somewhat lower in the newer Buckeye pool, Gladwin County. The oil processed by the Roosevelt refinery during August, 1937, had a gravity of 39.2 deg. A.P.I., and was handled at a rate of about 5000 bbl. daily. Salt is quite a factor in Michigan, as practically all the oil produced from the Dundee formation is contaminated with varying amounts of salt water, which increase rapidly in some fields, as for example, the Crystal field, which went almost entirely to water in less than two years.

At the Roosevelt refinery a 14-in. by 7-in. by 12-in. pump passes the oil through heat exchangers, distillate to oil, which bring the temperature of the charge to about 180 deg. fahr., after which it enters a large drum where it is given approximately three hours settling time. Water introduced with the fresh oil hastens the separation of salt from the oil by dissolving the minute crystals after the heat breaks down the film that surrounds the crystals. Before the crude enters the pipe still sufficient salts have been removed to prevent corrosion. Fuel oil, residuum from the second column, passing through other exchangers, heats the fresh charge, so that a tube still inlet temperature of about 275 deg. fahr. is obtained. The pipe still crossover temperature is held at approximately 390 deg. fahr., and the transfer line at a temperature of approximately 460 deg. fahr., oil entering the vaporizer section of the first fractionating column at about 405 deg. fahr., so that all desirable fractions can be removed from the column.

Reflux pump controllers

Eight normal cuts are taken from both columns, the first producing rubber solvent from the overhead vapor line, held at a temperature of approximately 190 deg. fahr., having wet trim, or reflux, so the required boiling range may be obtained on the product, which has an average gravity of 72.4 deg. A.P.I. The next cut removed directly from this primary column is the varnish maker's and painter's naphtha. The accumulator section temperature is maintained at approximately 226 deg. fahr., so the product drawn off at this point has a gravity of approximately 60.2 deg. A.P.I. Next down the column, Stoddard's solvent is produced, the draw-off section temperature being maintained at 300 deg. fahr., and the product having a gravity of 54.6 deg. A.P.I.

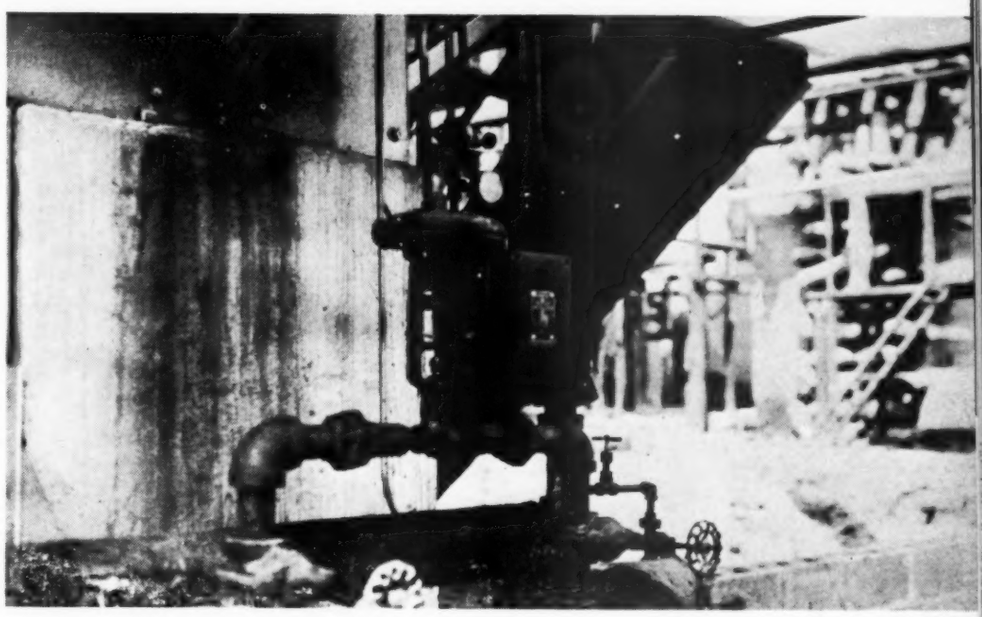
The bottoms, the fourth product taken from the column, is partially-topped crude, and the temperature of this material averages approximately



Shell and tube vapor condenser on first column

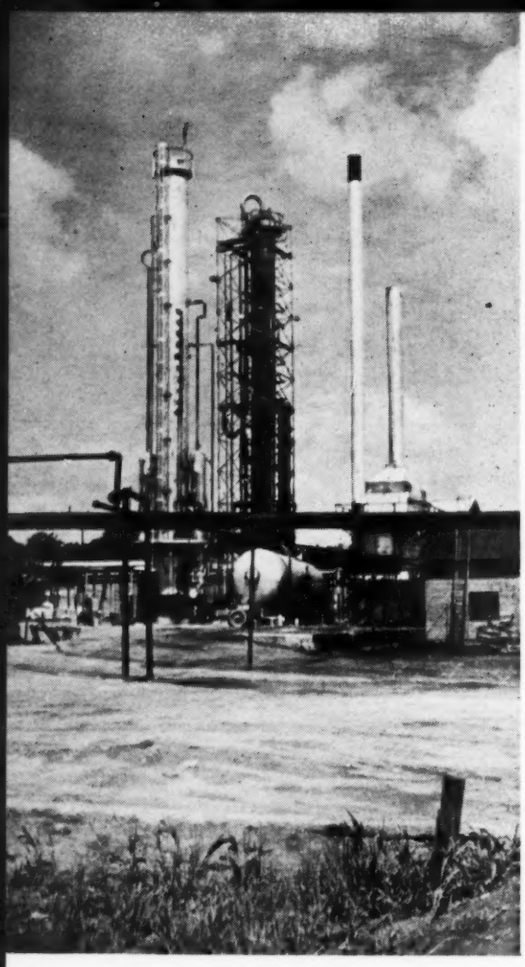
385 deg. fahr. as it emerges from the base and is picked up by the secondary charging pump. A 12-in. by 7-in. by 12-in. steam-driven, reciprocating pump is used to handle the hot oil, which is transferred immediately to the second pipe still for additional processing. The pipe still inlet temperature varies somewhat from that of the primary column outlet, but averages approximately 370 deg. fahrenheit. The second heater, or pipe still, is operated so that a transfer temperature of about 600 deg. fahr. is obtained, and the oil is flashed into the secondary fractionating column for final processing.

Four cuts are taken from this column, the heavier fractions varying according to market requirements. The overhead fraction is always kerosene,

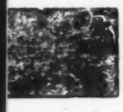


Fuel controller on first pipe still

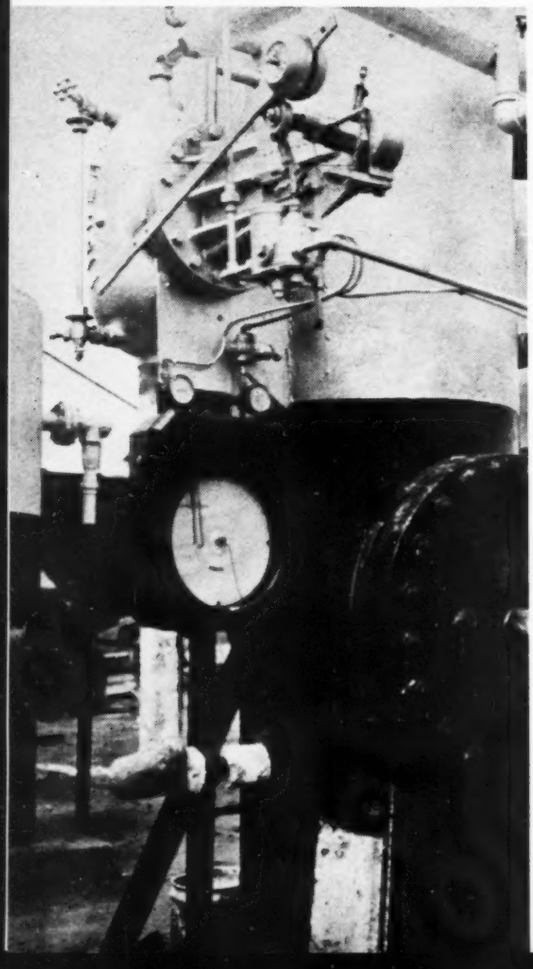
having an average gravity of approximately 46.5 deg. A.P.I., when the top of the column is maintained at a temperature approximately 400 deg. fahr. with liquid reflux. The vaporizer section of the secondary column has an average temperature of around 590 deg. fahr., which, with sufficient process steam, will separate all the required fractions from the partially topped crude charge. Two grades of distillate may be taken from the column at different drawoff connections, or the two merged into one from a common drawoff section, as preferred. During seasons when the demand for burning oils is greatest, the operation of the secondary column is altered so that two grades of distillate may be manufactured, but if only a single grade of distillate is required, its gravity averages around 41.6 deg. A.P.I. when the distillate section of the column is maintained at or near a temperature of 455 deg. fahrenheit. Gas oil is next removed from the tower, its gravity varying slightly as the operat-



Above—View of the two columns for double-flashing



Below—Vapor-recovery column and outlet controllers

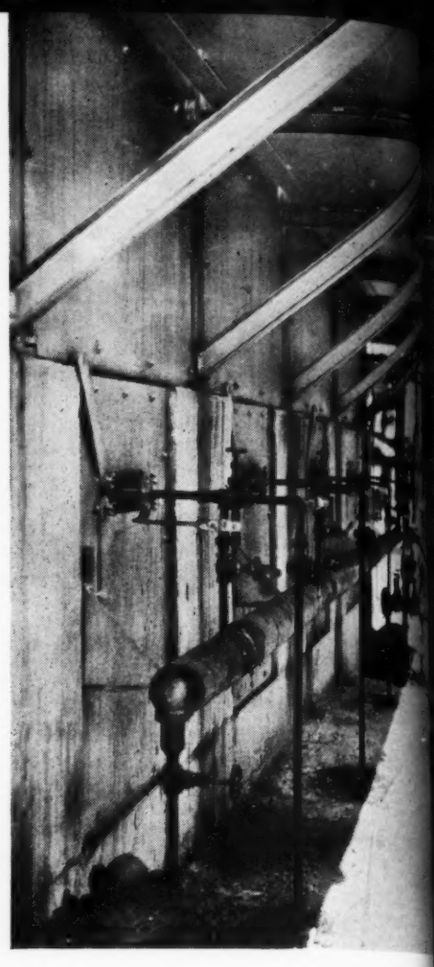


ing conditions of the column vary, but during summer months its average gravity is approximately 34.5 deg. A.P.I. when the the gas oil section is maintained at or near a temperature of 525 deg. fahrenheit. Bottoms leave the column at a temperature of approximately 550 deg. fahr., as 18.7 deg. A.P.I. fuel oil, when other operating conditions are as outlined above, and when charging this type of crude.

This system of double-flashing was decided upon to eliminate "bootlegs," or side cut, columns, as each cut can be removed directly from the column, finished as a designated product. Motor fuel can be cut from the top of the primary column by regulating the amount of reflux to obtain the desired end-point and gravity. It may be blended with other materials, or ethylized as desired. The entire plant has been revamped during the past 12 months to include new electrolytic salt removing units, new ethylizing equipment, as ethyl fluid is received now in tank cars, and equipment that processes all the vapors from plant rundown storage to recover the available fractions that otherwise would be lost by evaporation.

During the early part of 1936, a new power room was placed in operation. It provides electricity for plant lighting and for operating what motor-driven pumps are required. This equipment was placed in the extension to the boiler room, and consists of two 125-hp., 6-cylinder Diesels, each connected directly to a 156-kva., 125-kw., 480-volt generator. The location of the generating sets is such that an experienced operator may care for both this equipment and the boilers, as everything about the two units is practically automatic. All the latest features were included in the generating equipment, such as temperature control in the water jackets, etc. The jacket water is circulated by individual motor-driven pumps through an enclosed system, using atmospheric cooling sections over which water flows to control the temperature.

From January 1, 1936, until August 12, 1937, this power unit had consumed approximately 49,200 gal. of Diesel fuel and had produced about 1,088,160 kw-hr. of electricity. Approximately 2400 gal. of fuel are consumed monthly, which indicates that insofar as fuel is concerned power is generated at a very low rate. Not only does the equipment require very little supervision, but maintenance cost is quite low; no major difficulties were encountered in the 20½ months of operation.



Furnace burners with protective covering prevent drifting snow from interfering with efficient operation

Particulars regarding construction and some of the important items of equipment used are as follows:

New Plant—Ralph M. Parsons Company.

Buildings—Butler Manufacturing Company.

Pumps and Diesel Engines—Worthington Pump and Machinery Corporation.

Recorder-Controllers — The Foxboro Company.

Thermocouples — Leeds & Northrup Company.

Liquid Level Controllers—Fisher Governor Company.

Gate Valves—Henry Vogt Company.

Insulation—Johns-Manville.

Generators—Electric Machine Equipment Company.

Exciter Belts—Goodyear Tire & Rubber Company, Inc.

Heat Exchangers—The Griscom-Russell Company.

Towers—Muskegon Boiler Company.

Salt Removers—Petroleum Rectifying Company.
(Installed, August, 1937.)

New Ethyl Plant—Installed, August, 1937.

May the Season's joys be yours.
Each and every member of our
organization extends to you . . .
best wishes for the holidays
and the coming New Year.

THE CONTINENTAL SUPPLY COMPANY

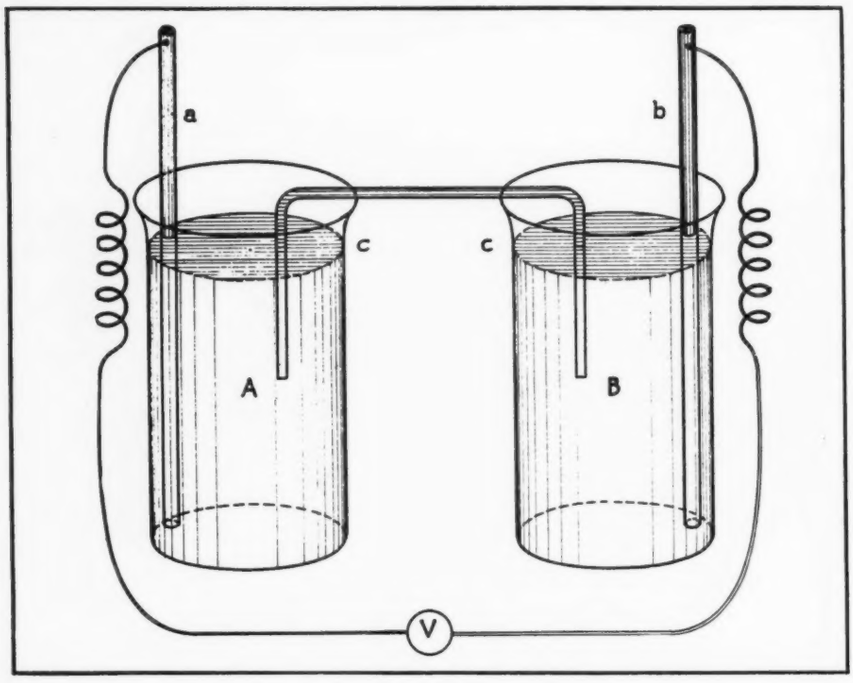


Fig. 1. Apparatus used in making experiment to determine type of salt most desirable in contact with ground bed pipe

Control of ground bed resistance, selection of site, and type of ground bed installed are important factors

Ground Beds for Use in Cathodically Protecting Buried Pipe Lines*

By S. U. McGARY

Engineer, United Gas System, Houston, Texas

THE theory of electrically protecting pipe lines against soil corrosion has now become an accepted fact and is being used more and more extensively each year. The principal question now to be considered is the economics of such a system over the old system of replacing the sections of pipe attacked by corrosion. In order to obtain the maximum results of cathodic protection it is necessary that all apparatus used in this type of protection be operating in the most efficient manner.

Cathodic protection consists essentially of installing, at some distance from the pipe line to be protected, a ground bed. Attached to this ground bed is the positive terminal of a source of electrical energy; the negative terminal being attached to the pipe line to be protected. As the system operates electrical current enters the soil at the ground from the ground bed and returns to the pipe being protected.

As direct current is used for protection of pipe lines the power consumed measured in watts is equal to the volts times amperes. In order to keep at a minimum the power needed and still obtain the same effect, it is necessary to keep the voltage at a minimum. The only method for controlling the voltage is to regulate the resistance of the circuit, which consists of wire, contact resistance between the ground bed and the soil, and the resistance of the earth between the ground bed and the pipe line. Obviously the resistance of the earth between the ground bed and the pipe line cannot be altered or controlled; however, the wire resistance and the contact resistance between the ground bed and the surrounding soil is controllable.

Control of Ground Bed Resistance

The resistance of the wire in the circuit is easily controlled by the size of the conductor used. Generally large wires, 4/0 or even larger, are used for this purpose.

The greatest loss of energy is the loss in overcoming the resistance of the contact between the ground bed pipes and the surrounding soil. This is not so easily controlled. This contact resistance is often many times as great as the resistance of the copper cable carrying electricity from the unit to the ground bed.

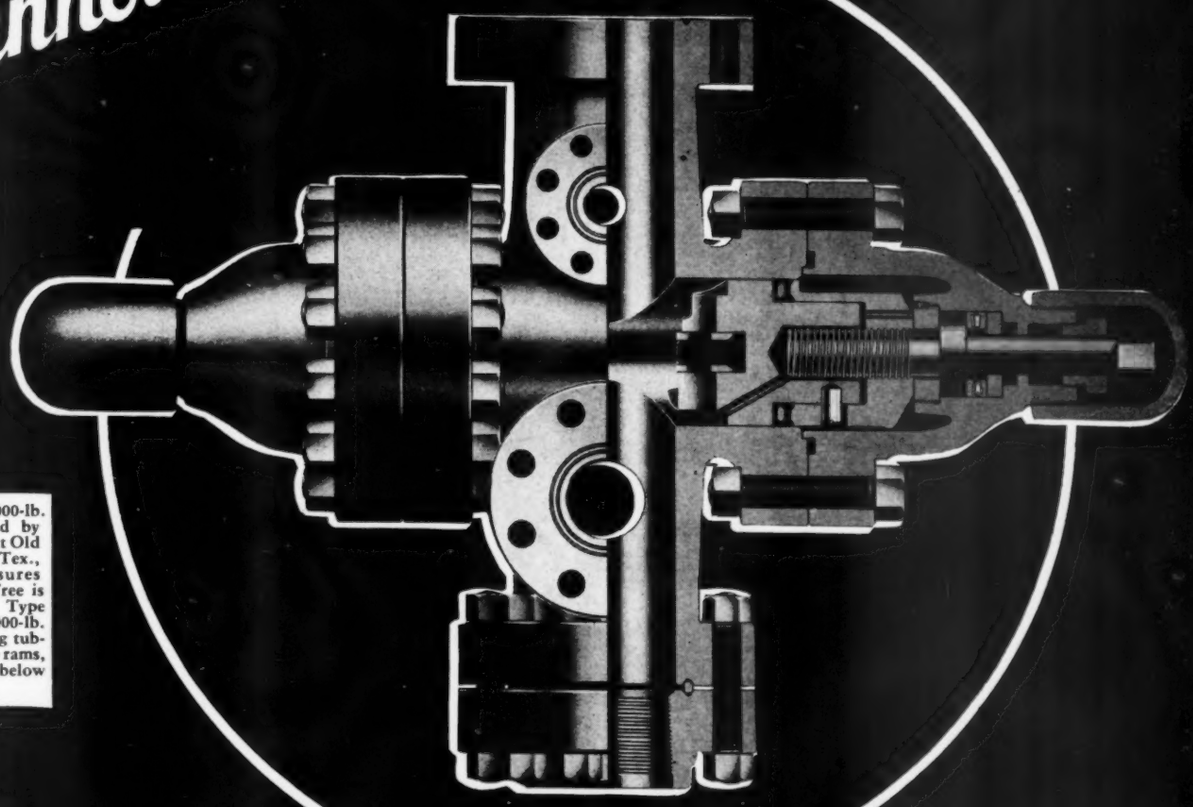
Soil is composed of infinitely small particles of complex silicates, oxides, and carbonates of calcium, aluminum, iron, etc. These insoluble materials are, in the pure state, insulators of electricity. Especially in areas where pipe lines are corroded these particles of insoluble material are covered with water. During wet seasons of the year the infinitely small spaces between the particles likewise are filled with water. In this water, which is in contact with these small particles, is dissolved salts that have a tendency to ionize and to conduct electricity. The conductivity is dependent on the kind and quantity of salt dissolved in this water. As salt is the controlling factor in the conductivity of a soil a laboratory experiment was carried out to ascertain the type of salt most desirable in contact with the ground bed pipe.

Two short pieces of pipe (a) and (b), Fig. 1, were selected so that when tested together in the same beaker of ½ percent (salt) water it showed

*Paper presented at Fourth Conference on Underground Corrosion, United States Bureau of Standards, Washington, D. C., November 15-17, 1937.

Cameron announces

its new TYPE 7-MR-6000 lb. Test and 10,000 lb. Test manually operated Blowout Preventer and Control Head



BELOW: Standard 10,000-lb. test Christmas Tree used by Harrison & Abercrombie at Old Ocean, Brazoria County, Tex., where completion pressures range up to 4,200 lbs. Tree is built up on a Cameron Type 7-MR Series 1500—10,000-lb. test Control Head, having tubing flow outlets above the rams, and casing flow outlets below the rams.

Regardless of anticipated well pressure, Cameron Type 7-MR 6,000- and 10,000-pound test Christmas Tree Control Heads provide extremely positive mastery at every stage of drilling-in and completion work when used as the foundation for high test Christmas Trees.

Complete blowout protection is afforded while drilling-in with drill pipe or tubing while running liner and screen on drill pipe or tubing; and while screen is washed outside prior to setting liner packer. Full safety also is provided while washing well clear to surface, if desired, before setting liner packer. Finally, an incomparably simple and efficient means of suspending and sealing tubing is provided.

Tubing is suspended on the closed rams of the Control Head by use of a special steel shoulder nipple, having the same O.D. as the tubing collars. Made up in the tubing string at the proper position, the one-piece shoulder nipple may be raised and lowered freely in the oil string without restricting returns. There is nothing to hang up, get out of order, or fail. When rams are closed on the shoulder nipple, tubing string is rigidly suspended, sealed beyond possibility of leakage, and rigidly held down. Wells completed with these Control Heads do not develop tubing and casing pressure equalization due to leakage of tubing seal.

Units are available with any desired combination of casing and tubing flow outlets. If preferred, tubing suspension may be by means of a special steel hanger landed in the top opening of the head. This permits arrangement of casing flow outlets above the rams, which then serve as a positive means of sealing annular space below casing outlets in event flow connections require repair or changing.

Cameron Christmas Tree Control Heads are available for all test pressures ranging from 3,000 to 10,000 pounds. Details and prices on Control Heads and Complete Cameron Safety Christmas Trees will be gladly furnished to any operator on request.

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MEXICO:
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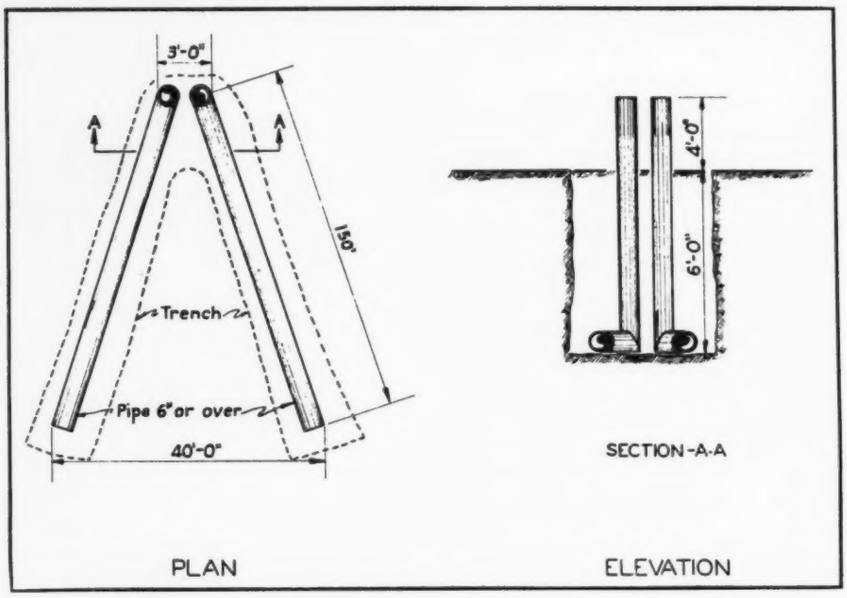


Fig. 2. Horizontal ground beds

the same potential. One piece was placed in beaker (A) surrounded by a solution of 1/20 percent sodium chloride (common salt). This is used to represent the pipe line buried in a slightly brackish solution. The other is placed in beaker marked (B) in which the solutions are changed in concentration as well as the type of salt. The instrument marked (V) is a low reading voltmeter used in measuring the difference in voltage. On top of each beaker is a layer of oil (c) used to exclude the air. In actual installations, but little, if any, oxygen will be found at pipe line depth in soils that are not cracked. It is for this reason that oxygen is removed and excluded in this experiment.

Beaker (A) is used to represent the pipe line and consists of a nipple immersed in 1/20 percent oxygen free solution. This is kept consistent throughout the experiment. In beaker (B) are placed different types of salt that have been and are being used for decreasing the resistance between ground bed pipe and soil.

This experiment shows the effect of different types of salt when placed in contact with the ground bed, as well as the effect of carbon as a ground bed material.

Ground beds composed of combinations such as No. 2 and No. 5, Table 1, would not be as efficient as those constructed using the other combinations of iron and salt. Ground beds constructed as outlined under No. 2 and No. 5 would create an electromotive force in the opposite direction from the one desired to protect the pipe line and would have to be overcome by applied voltage from the unit protecting the pipe line.

If we were operating a unit delivering 100 amperes using a ground bed as outlined in No. 2 and No. 5, 60 watts of the power would be used overcoming electromotive force due to improper ground bed construction. Installations such as outlined in No. 1 and No. 4 would produce an electromotive force in the same direction as that applied by the unit. It will have a tendency to reduce the power consumed in the installation.

Types of Ground Beds

Ground beds have been divided into two types, horizontal and vertical.

A horizontal ground bed is installed by opening a trench approximately six ft. deep and placing in it a continuous length of pipe. This depth will vary according to the moisture level of the soil. Two such trenches ordinarily are used, the pipe forming the letter V, (Fig. 2). At the point where the two buried lines come together a riser is welded that protrudes above the ground. To this riser is brazed the copper cable from the generating unit.

The other type of ground bed is known as the vertical type. It consists of a number of pipes placed in a vertical position, the tops of the pipes being connected to each other.

The first ground beds of this type were installed by drilling the holes to a depth of 12 or 14 ft. and inserting the pipes. These ground beds were not very effective, as a large portion of the pipes inserted was in a very dry soil, leaving only the lower portion of the pipe to discharge electricity into the soil.

Later the vertical ground beds were installed with a core-drilling machine that had been equipped with large-diameter bits for the purpose of setting 20-ft. random length pipe.

As shown in Fig. 3 the hole is made deep enough so that the top of the pipe will be at least two ft. below ground line. Four-inch junk pipe is welded on the tops of these pipes in order to tie them together and form an electrical path. The hole both inside and outside is filled with drilling mud after the pipe is lowered into place. This type of ground bed has proved very satisfactory.

The advantages of the vertical ground bed are as follows:

1. A large portion of the pipe is in contact with the soil where permanent moisture prevails with the result that there is very little seasonal fluctuation of ground bed resistance.
2. The ground is uniformly in contact with every portion of the ground bed pipe.
3. The initial resistance will remain practically constant thus allowing the operator to adjust the unit.
4. The drilling rig is capable of putting the vertical pipes as much as 40 ft. deep.
5. The cost is comparable with installing ground beds of the horizontal type.
6. Any kind of soluble salt can be mixed uniformly with the soil adjacent to the vertical pipes.
7. When the pipe has been lost to the extent that a new bed is desirable it may be renewed simply by driving a smaller diameter pipe inside the old one.

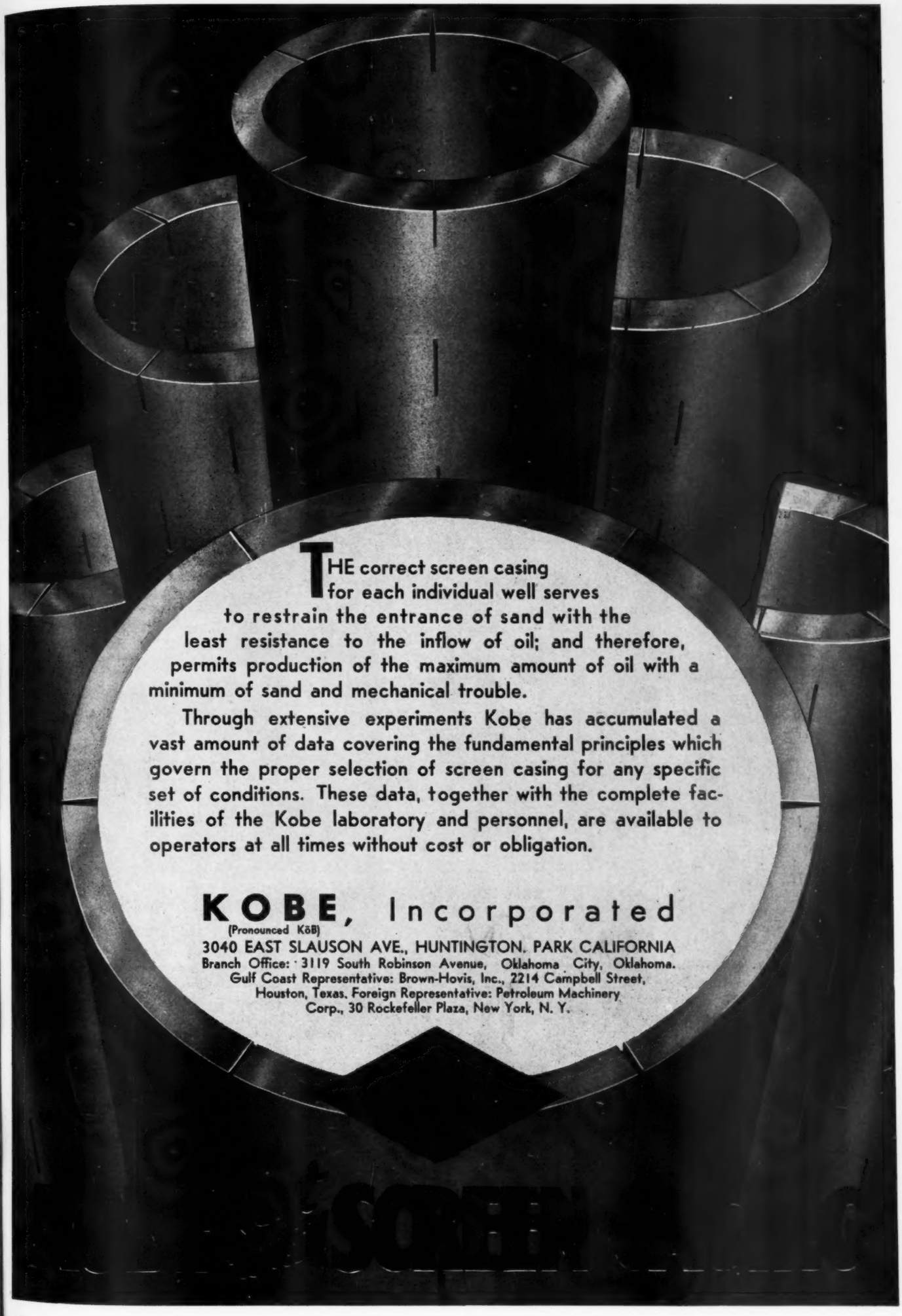
Horizontal ground beds have the following advantages:

1. They may be installed by ordinary labor crews without special equipment.

TABLE I

No.	*Contents of Beaker B*	*Concentration*	*EMF*
1.	Sodium Chloride	1/20% to 2.0%	0 to .05 V. Anodic
2.	Copper Sulphate	1/20% to 1%	.6 V Cathodic
3.	Calcium Chloride	1/20% to 1%	.05 to .15 Anodic
4.	Calcium Chloride and Acetic Acid	1% Cace - Trace Acid	.22 Anodic
5.	*Carbon rod in Sodium Chloride	1/20% to 2.0%	.6 Volt Cathodic

*Carbon rod used to replace the steel nipple.


THE correct screen casing
for each individual well serves
to restrain the entrance of sand with the
least resistance to the inflow of oil; and therefore,
permits production of the maximum amount of oil with a
minimum of sand and mechanical trouble.
Through extensive experiments Kobe has accumulated a
vast amount of data covering the fundamental principles which
govern the proper selection of screen casing for any specific
set of conditions. These data, together with the complete fac-
ilities of the Kobe laboratory and personnel, are available to
operators at all times without cost or obligation.
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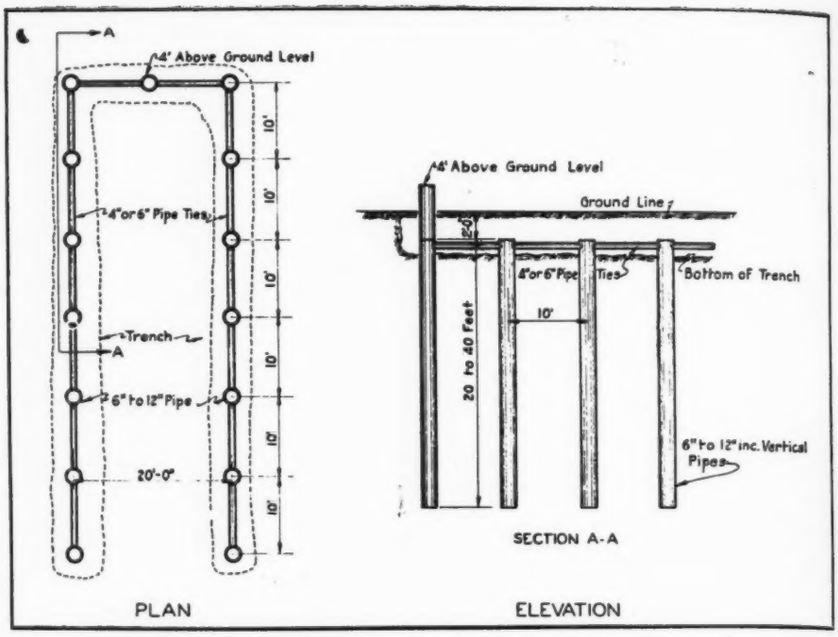
Corp., 30 Rockefeller Plaza, New York, N. Y.

Fig. 3. Vertical ground beds



2. Any size pipe may be used. The pipe does not have to be straight.
3. The addition of salt to the soil adjacent to the pipe will be simplified.

Selection of Ground Bed Sites

Great care should be taken in selecting the site for installing a proposed ground bed. Test holes should be drilled on each side of the proposed location to the depth that the ground bed will be installed. Samples of soil are taken and resistance measurements made. If the soil is of the same kind preference is given to the location showing the lowest soil resistance per cubic centimeter. In event one soil is of a sandy nature and the other is a clay, better results will be obtained if the ground bed is placed in the clay regardless of resistance measurements. Ground beds installed in salty marshes that continually are full of brackish water need only be just covered.

After a ground bed is installed and connected to the source of power excellent results will be obtained with a resistance of 1/10 ohm or less. If the resistance is greater than 1/10 ohm steps may be taken to reduce the resistance in order to operate efficiently.

This procedure is followed:

1. Reduce the resistance of the soil in contact with the ground bed pipe by the addition of salt. If the ground bed consists of at least 300 ft. of 6-in. pipe or the equivalent amount of steel surface in contact with the soil, salt should be added to the soil adjacent to the pipe. In arid locations calcium chloride should be used, but at locations where the ground bed is covered with fresh water satisfactory results can be obtained by using sodium chloride.
2. Increasing the amount of pipe in contact with the soil will help. This method of reducing the resistance will increase the initial cost of installation, but will reduce materially the operating costs. This is due to the fact that current leaving iron pipe on entering the soil removes approximately 20 lb. of iron a year. A longer period of operation will be experienced before it will be necessary to renew the ground bed.
3. In adding pipe to the ground bed it has been found that much more is gained for the effort spent if the additional sections are placed some distance from the original installation. A few installations were made in this manner by placing the auxiliary beds some 100 ft. on either side and connecting with a heavy wire.

SUMMARY

The subject of ground bed resistances may or may not be of importance if, for instance, a rather short section of pipe was to be protected. Neither would it be so important if power could be had at practically no cost.

It is important, however, if power must be purchased at commercial rates. It also is very desirable with the use of windmills. A windmill is not a very powerful piece of equipment under ordinary wind velocities. By restricting the resistance of its load far better returns will be obtained for the investment. In this instance the cost of power is nil.

Sealing of Oil Sands by Drilling Mud

DEMONSTRATION by engineers of the Bureau of Mines, United States Department of the Interior, that drilling mud may "set" and become as hard as shale, when in contact with crude oil for a relatively short time, may have a far-reaching effect on methods of developing and operating oil fields. If the experimental work can be applied successfully in the field, it is possible that millions of barrels of oil that are not recovered by present production practices will be made available.

The operator who drills a well with rotary tools uses mud to carry the cuttings to the surface. As drilling proceeds, the mud fluid plasters the sides of the hole. The colloidal particles in the mud prevent the drilling water from leaving the well and entering the porous strata that are penetrated.

If the drilling mud solidifies on the walls of the hole where it penetrates oil-bearing strata it is possible that many wells have been drilled through low-pressure oil-bearing formations which, after the well was completed, have become sealed.

To overcome this difficulty engineers of the Bureau devised a means of processing drilling mud with material insoluble in water but soluble in oil, so that when an oil stratum is penetrated the hydrocarbons will attack the oil-soluble portions of the mud and pass through it into the well. The most effective material is crude rubber cut into shreds. The effect is as though short pieces of string had been mixed with the mud plaster and pulled out after the plaster was in place, leaving holes through which the oil and gas can enter the well.

The hardening of the mud and proposed method of processing it are described in Report of Investigations No. 3354, entitled, Hardening of Mud Sheaths in Contact with Oil, and a Suggested Method for Minimizing Their Sealing Effect in Oil Wells, by C. P. Bowie, supervising engineer of the bureau's petroleum field office at San Francisco, California. This report may be obtained without cost from the Bureau of Mines, Information Division, Washington, D. C.

ANY WAY YOU LOOK AT 'EM...

HERE ARE THE **REASONS WHY**

BAASH-ROSS

Self-Aligning ROTARY SLIPS

INSURE SAFETY, SAVE MONEY, SPEED OPERATIONS, PROTECT YOUR DRILL PIPE!

1. Liners maintain a full-length, non-crushing, non-slipping grip on the pipe because the gripping surface is automatically aligned with the pipe in any position.

2. Complete full-length and perfect circumferential contact of liners with pipe insures uniform distribution of weight over entire large gripping area. Concentration of weight on small area of pipe is avoided—damage to pipe eliminated.

3. Truncated-pyramid type wickers on gripping surface cannot cut or mar pipe.

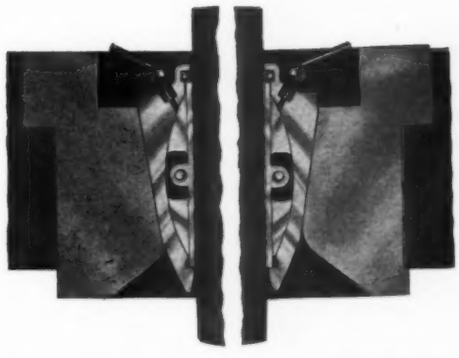
4. Oscillation of liners when pipe is raised insures immediate release of slips. No sticking in master bushings—no lost time.

5. All working parts secured against accidental separation. Retaining pins, etc., not subject to strain under load.

6. Slips quickly disassembled on derrick floor for replacement of liners. No special tools required.

THE SELF-ALIGNING PRINCIPLE EXPLAINED

BAASH-ROSS SELF-ALIGNING ROTARY SLIPS AUTOMATICALLY COMPENSATE FOR CHANGE IN EFFECTIVE TAPER OF THE MASTER BUSHING BORE



In the left half of the cross section diagram you see a Baash-Ross Self-Aligning Slip seated in a new master bushing. The taper on the slip body coincides with the taper of the master bushing bore, and the liner has full length contact with the pipe. Now look at the right-hand side. Note how wear in the bore and on the outside diameter of the master bushing combine to change the EFFECTIVE TAPER of the master bushing. Because the liners of Baash-Ross Self-Aligning Rotary Slips are supported laterally in the slip body-sections by curved backing plates, they oscillate in a vertical plane and are automatically aligned with the axis of the pipe in any position. Thus, the weight of the string is uniformly distributed over the entire large gripping surface of ALL the liners, without damage to the pipe.

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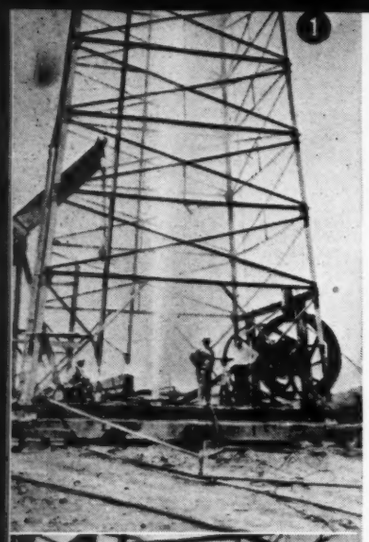
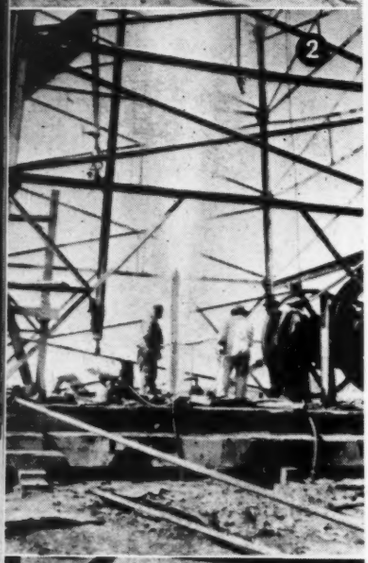
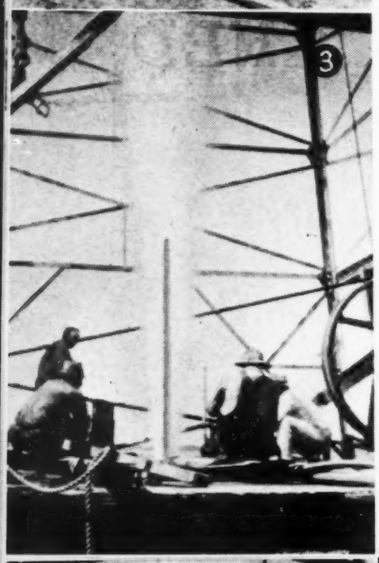






Controlling a High-Pressure Gas Well in Otis Field, Kansas

THE accompanying photographs show most graphically and interestingly the struggle involved in bringing under control a high-pressure well in the Otis gas field of Rush County, Kansas. The well is No. 4-B Korial of Morgan, Flynn and Cobb, Tulsa, Oklahoma, operators.

The well had been killed with water, after which the operators bailed it until the gas pressure exceeded that of the water and it began to empty of its own accord. At one time the water was shooting over the top of the derrick. When an attempt was made to lower the bit into the hole and fasten the oil-saver in the top of the control head it was found that the pressure was too great and it was impossible to seat the oil-saver on the packing ring. While trying to get the oil-saver in place the cutting action of the gas, sand, and water severed the drilling line immediately above the rope socket. The oil saver was blown up into the derrick and the bit dropped into the casing. Later the bit came back up to the position shown in the accompanying illustrations. The pressure was too great for the bit to drop into the casing, but not great enough to blow it completely out of the hole.

A 5-in. bit and 7-in. O.D. casing were being used. An attempt to tie a rope around the bit was unsuccessful, as the rope was cut into shreds by the water, gas, and sand. Next a wire line obtained from a winch on a truck was tied around the bottom of the bit, then the drilling line was lowered to secure the top of the bit with a half-hitch. By tightening both lines the bit easily was snubbed out of the hole. A few days later the well again was killed and the bit lowered into the hole before too much of the water had escaped.

The well was producing 60,000,000 cu. ft. of gas and the pressure was 950 pounds. When the bit was out of the hole the well was shut in by one man closing the Orbit valve with an 18-in. wrench. We are indebted to Bill Ligon, Kansas representative of the Oil Well Improvements Company, both for the photographs and information incorporated in this article. A snapshot of Mr. Ligon appears below.

BILL LIGON

ILLUSTRATIONS

No. 1. The well unloading. Budge Flynn and Olin Harkins are seen standing on the derrick floor.

No. 2. Trying to tie a rope onto the bit. Olin and Jim Harkins on derrick floor; Russell Cobb at left.

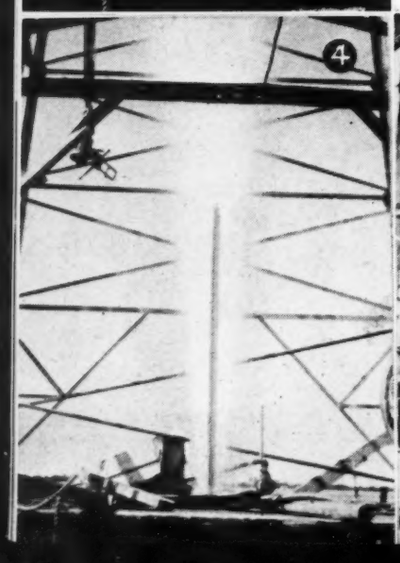
No. 3. Crew attempting to snub a rope around the bit. Gas, water, and sand cut the line to pieces.

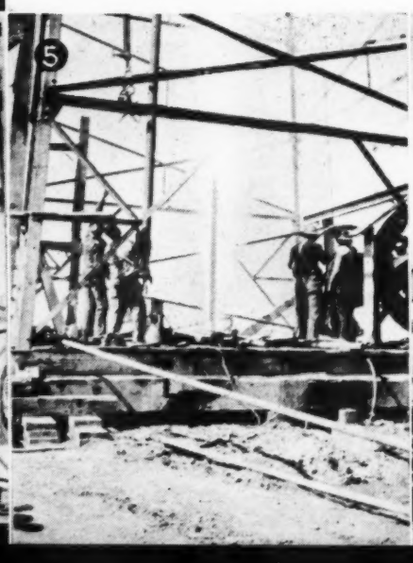
No. 4. The bit can be seen suspended in the top of the casing. The drilling line is dangling in the upper right hand corner.

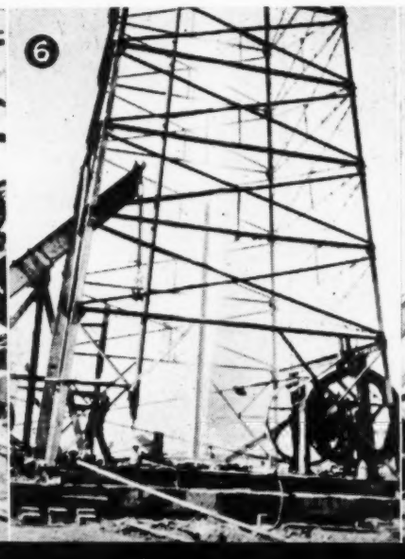
No. 5. Bit suspended in casing. The bit has a truck winch line half-hitched just above the control head. The crew is lowering the drill line to tie to the top of the bit.

No. 6. Pulling the bit out of the hole.

No. 7. The bit is almost out of the hole. Jewell Harmon is closing the 7-in. Orbit valve with an 18-in. wrench; 950-lb. pressure, 60,000,000 cu. ft. of gas.



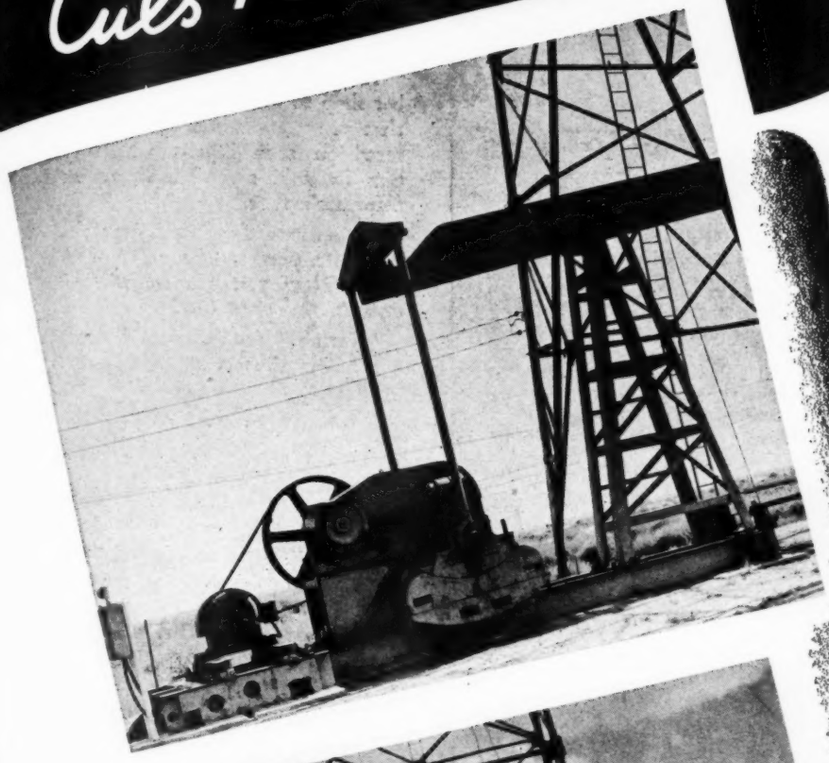


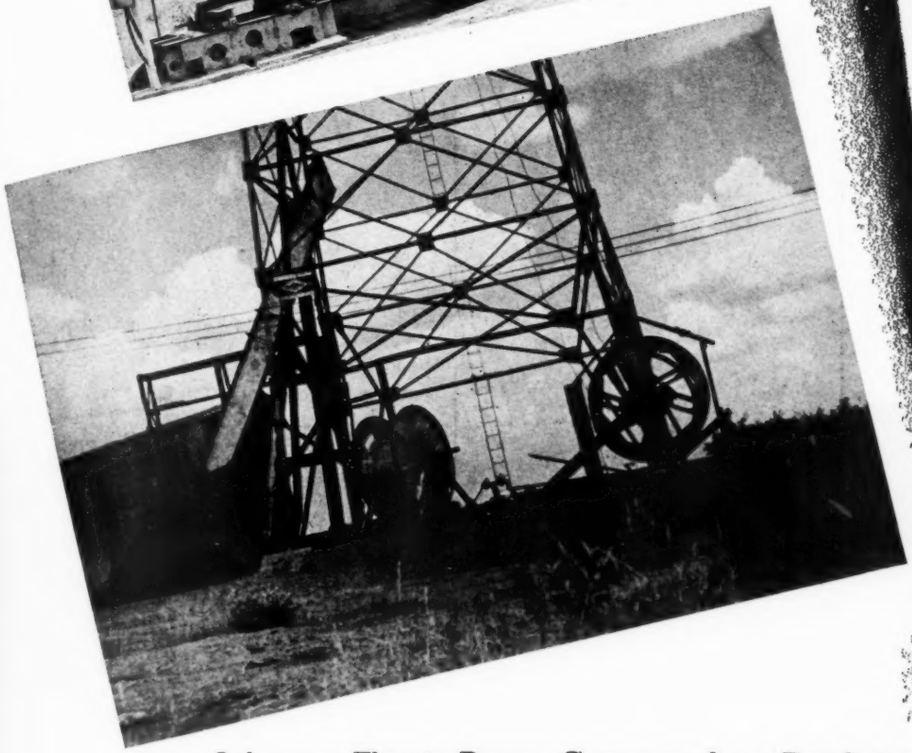


ONLY FEW OF MANY WAYS

PURCHASED ELECTRIC POWER

Cuts Production Costs . . .





- Lower first cost
- Lower operating, maintenance and labor cost
- Lower Fixed charges (taxes, interest, insurance, depreciation, etc.)
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- Dependable performance at all times
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- Extreme Portability
- Quiet, clean and modern
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Ask your Electric Power Company how **Purchased Electric Power** can increase your profits!

PETROLEUM ELECTRIC POWER CLUB

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

What business needs is more orders from customers and fewer from the Government.

* * *

Joe: Are you and your wife on speaking terms?

John: Well, I'm listening again.

* * *

A woman is a person who can hurry through a drug store aisle 18 inches wide without brushing against the piled up tinware and then drive home and still knock off a door of a 12-foot garage.

* * *

Nurse: I think he's regaining consciousness, doctor; he just tried to blow the foam off his medicine.

* * *

Frisby: My girl has a beautiful gown that she only wears to teas.

Frump: Who?

Frisby: Me.

* * *

Old-Fashioned Aunt: Sally, I should think that a night club would be the last place a girl of your station would go.

Sally: It usually is.

* * *

Residents in Reading, Pa., are hearing this story about WPA activities:

Needing a man to mow her lawn a woman telephoned WPA officers to learn if a man were available for odd jobs. The WPA office promised to take care of the job. Next day a truck loaded to the rails with boards and nine men drew up in front of the house.

Thinking there was some mistake, the woman hurried out to prevent unloading of the lumber. "I only wanted the lawn mowed," she said.

"It's all right, lady," a man who appeared to be in charge told her.

"This is now a federal project. We will build a rest room with the lumber, as required by the rules. Two of the men will be sitting in it all the time, two will be going in and two going out all the time. The other two will cut the grass. I'm the superintendent."

* * *

"Is there any difference between results and consequences?"

"Well, my experience has been that results are what you expect, while consequences are what you get."

Farmer: Seems like I've been findin' an awful lot of dead crows in the fields lately.

Second Farmer: Yeah, Joe Welch down the road made a scarecrow out of the duds his boy brought home from college and the birds have been laughin' themselves to death.

THE MORNING AFTER THE NIGHT BEFORE

at the Christmas Jinks and Banquet of the Wildcat Committee, California Oil and Gas Association

On a cold grey dawn of a winter's day,
A wildcat wended his homeward way
And with stumbling footsteps he said,
"Methinks
That was damn good Christmas Jinks!
I'm certainly glad I 'up and went'—
'Twas the best five bucks I ever spent!
Of course it's going to be real tough
Explaining to Mary what kind of stuff
They mixed with oil and gasoline
To make me feel like 'sweet-sixteen'.
That show—and what went on before—
Raised my octane to ninety-four;
The dinner—well, they said it was great,
Though I don't remember just what I ate.
A couple of times I fell on my face,
But aside from that I behaved with grace
And upheld the dignity which, to be frank,
Belongs with vice-presidential rank.
It may be hard for wildcats' wives
To see how oil can shape our lives;
But, take last night—'twas an education,
A stimulus to the imagination,
A rare symposium of wit,
Blended with just a little bit
Of that which wildcats all have found
Makes the world go 'round and 'round.
In a world gone nuts with war and strife,
An industry took a lease on life,
For after last night I'm here to say
That I really believe oil's here to stay."

One inmate of the insane asylum was playing solitaire, with another one watching over his shoulder. "Say," said the second, "you just cheated yourself."

"Oh, sure," replied the first, "I've been cheating myself at solitaire for years."

"Don't you ever get caught?"

"Naw, I'm too clever at it."

Flossie: You'll never catch me going out to dinner with an editor again."

Girl Friend: Why? Was he broke?

Flossie: I don't know whether he was broke or not, but he put a blue pencil through about half my order.

* * *

A reformer went into a Negro barber shop to get a shave. It so happened that the barber was gloriously plastered on corn liquor, which caused him to make several bad cuts on the reformer's face.

Whereupon the latter, ever alert to call attention to the evils of drink, said: "Now you can see what booze does!"

"Yessuh," replied the Negro, genially, "hit sho do make de skin tender!"

* * *

The tightwad insurance inspector who was out of town for his wife's birthday sent her a check for a million kisses as a present. The wife, a little annoyed at his thrift, sent back a post card:

Dear Jim: Thanks for the perfectly lovely birthday check. The milkman cashed it for me this morning.

* * *

Hubby: Do you know, honey, if I had to do it all over again, who I'd marry?

Wifey: No, who?

Hubby: You.

Wifey: Oh, no you wouldn't.

* * *

"My son's home from college."

"How do you know?"

"I haven't had a letter from him in three weeks."

* * *

A state inspector of a lunatic asylum went to the telephone and found difficulty in getting his connection. Exasperated, he shouted to the operator: "Look here, girl, do you know who I am?"

"No," came back the calm reply, "but I know where you are."

* * *

Doctor: I don't like to mention it, but that check you gave me has come back.

Patient: Well, that sure is funny, Doc, so did my lumbago.

SAFE, DEPENDABLE, CEMENT GUIDING, FLOATING AND CEMENTING EQUIPMENT IS ONE OF THE MOST ECONOMICAL FORMS OF INSURANCE YOU CAN BUY . . .

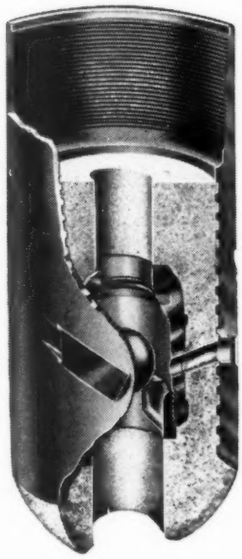
POPULAR MAKE CAR

Original cost $800
Cost Over 2 Year Period on Depreciation Basis $400
Insurance Cost (Broad Coverage) for 2 Years $150
OR 37½% of the TOTAL INVESTMENT

AVERAGE OIL WELL

Depth . . . . . 3800'
Total Investment $35,000
Insurance on the entire Casing Program (in the form of Safe, Dependable Landing and Cementing Equipment) Consisting of . . .
One 13⅜" Baker Cement Guide Shoe
One 9⅝" Baker Cement Whirler Float Shoe
One 7" Baker Cement Baffle Collar, with Hole
One 7" Baker Cement Whirler Float Shoe
Would Cost an Average Maximum of $250
Or Less Than ¾ of 1% of the Total Investment
This percentage includes the necessary Shoes so that the *insurance cost* of the floating feature is practically negligible.

It is perfectly obvious that it is just "good business" and "good insurance" to use the Safest and most Dependable Equipment available . . . and to modern operators that means BAKER CEMENT GUIDING, FLOATING AND CEMENTING EQUIPMENT.



Sectional View Baker Cement Whirler Float Shoe

IT IS THE COMBINATION OF THESE 3 FEATURES *In Perfect Balance* THAT ASSURES THE SAFETY AND DEPENDABILITY OF BAKER CEMENT GUIDING, FLOATING AND CEMENTING EQUIPMENT . . .

1. ***IT HAS STRENGTH*** . . . and strength to spare for landing the longest and heaviest string of casing.

2. ***IT HAS EFFICIENT VALVE ACTION*** . . afforded by buoyant Bakelite ball which floats in the rotary mud or cement slurry and instantly double-seals against a narrow, tough rubber seal (backed by a Bakelite seat and concrete) at the slightest reversal of pressure.

3. ***IT IS COMPLETELY DRILLABLE*** . . . only special Baker-Formula Concrete, a minimum amount of Bakelite, and a negligible amount of rubber are ever used in the internal construction of Baker Floating Units—these materials all being easily drilled up and circulated out of the hole. When *less drillable* materials are used, the operator is confronted with extra bit expense and loss of time in drilling out, or breaking out such materials from the shoe or collar. Moreover, there is always danger that the recently set cement around the casing will be damaged by the continued grinding, action of the bit during the drilling out process.

The Complete Story of the Safety and Dependability of Baker Cement Guiding, Floating, Cementing Equipment is Given in the Baker Section of the 1937 Composite Catalog . . . and in the large Baker Catalog, gladly sent upon request.

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BAKER CEMENT GUIDING FLOATING & CEMENTING EQUIPMENT

Quick Reversals in Acid Treatment of Oil Wells

Improved results obtained by quick reversal of flow and shortening the shut-in period

By M. E. CHAPMAN*

THE procedure of quick reversals or rapid withdrawal of solutions in connection with acid treating of wells steadily is gaining favor with operators in the Mid-Continent area. Ordinarily in limestone reservoirs, because of the preponderance of carbonates found, hydrochloric acid is quickly neutralized. This is particularly true in wells that take acid "under vacuum" or in which the pressure "breaks."

During the earlier days of acid treating, wells were shut in for 48 to 72 hours, awaiting chemical reaction. Experience has proven that protracted shut-in periods are not desirable. In fact, harm can and probably does result from wells being shut-in for too long a period. Virtually no limestone beds are pure limestone. They contain shale, sand, chert, anhydrite, gypsum, iron and aluminum compounds, and associated metal compounds. The occurrence of these impurities is particularly marked in the Siliceous lime of western Kansas and the Permian lime in New Mexico. Hydrochloric acid readily reacts with metal oxides. Acid under the pressure and temperature encountered in acidizing also reacts with compounds other than the oxides. The metal compounds formed are soluble in acid mixtures; but when the solution becomes neutralized or almost neutralized these compounds are precipitated as aluminum or ferric hydroxides. These hydroxides may form pore-clogging material and retard the flow of oil to the well bore.

As previously mentioned, sand, shale, and other materials occur as partings or are distributed through the limestone matrix. When the limestone or dolomite is dissolved by the action of acid these particles may remain to interfere with oil flow. In addition to the desirable removal of the products mentioned the reversal of direction of flow after acid has partially completed its work of solution allows the acid to work while flowing both ways. This procedure permits a dissolving action as acid is entering the formation and favors an enlarging of drainage channels upon reversal. A small amount of unspent acid can do little good if allowed to remain widely spread in the drainage area of a well; further, there is an economic justification for this procedure in that operators are enabled to place their wells on production two or three days sooner.

The general characteristics of most producing limestones, including the presence of "foreign" material, are well known. Minor variations occur even from well to well. A microscopic examination or a simple inspection of cores or cuttings will aid in determining acidization procedure.

A thoroughly experienced treater and engineer are in the best position to make recommendations at the well on shut-in time at the completion of the job. The time required for treating, pressures encountered, breaking point, etc., each has a bearing on the time allowed for reaction.

In summary, acid-treating produces better results if the flow is quickly reversed and the closed-in period reduced, even though some unspent acid may be brought to the surface and wasted. If the acid treatment continues long enough to neutralize the acid completely reaction products and residues may partially clog the production zone and reduce the value of the treatment.

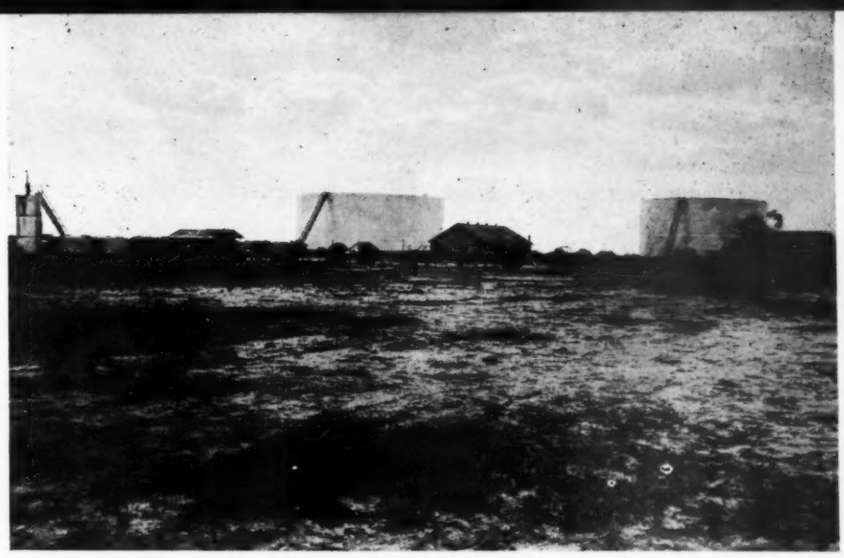
*The Chemical Process Company, Tulsa, Okla.

Pilot Copper-Sweetening Plant on Wheels

A "sweetening plant on wheels" enables Perco, Inc., of Bartlesville, Oklahoma, to demonstrate the merits of their Perco copper sweetening process on the home grounds of interested refiners and natural gasoline manufacturers. A pilot copper-sweetening plant has been installed in an especially-built, all-steel trailer about the size of an ordinary house trailer. The plant is an exact duplicate of commercial-sized units, complete in every detail, and is capable of sweetening 35 or 40 bbl. of gasoline a 24-hour day. The interest already shown in this novel miniature plant and the number of requests received for its services indicate that it will be very busy for several years.

This test plant can be driven right to the refiner's door, tied into his gasoline stream just before it goes into his present sweetening equipment, and proceed to process his product under the same conditions as does his present equipment.

Analyses of samples of the product sweetened by his present and by the copper-sweetening process enables the refiner to compare the two products for color, color stability, gum, induction period, degradation of octane rating, lead susceptibility, tetraethyl lead savings to specified octane number, and any other tests required locally for an economic comparison.



Valley Pipe Line Company's Jackson station in the Sam Fordyce field (beginning of 15-mile extension). Receiving tanks for crude from field gathering lines are shown. Capacity: One 55,000-bbl. and one 20,000-bbl. welded tank. Pump station is behind water dike, or fire wall, in center

Extension to Oil Line is Dresser Coupled

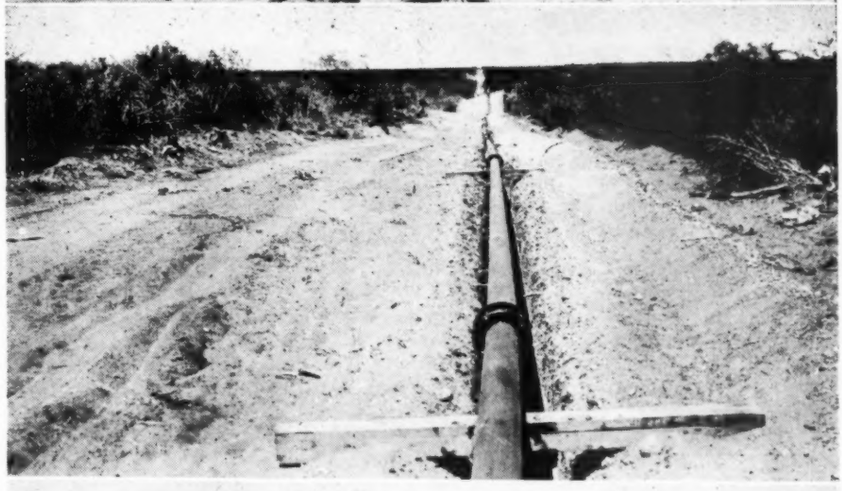
THE Valley Pipe Line Company recently completed a 15-mile extension to its 5½-in. Dresser-coupled oil line laid in 1935 between the Sam Fordyce field, Hidalgo County, Texas, and Port Isabel. This line will be recalled as one the laying of which was characterized by a departure in oil line construction practice, in that the joints were connected with Dresser Standard Style 38 couplings throughout the length of the line.

The extension runs through Cameron County, Hidalgo County, and into Starr County. The diameter of the pipe is 5½-in. O.D., the same as the original line. Fifteen days were required to lay the new line.

The average working pressure of the line is 450 lb. per sq. in., although this varies and sometimes is as great as 650 lb. per sq. inch. The pipe, having a wall thickness of approximately 3/16 in., was manufactured by the Republic Steel Corporation, and was supplied in 40- and 45-ft. lengths.

The entire line, including the extension, is in charge of H. H. Hensley, McAllen, Texas, general manager of the Valley Pipe Line Company. Hensley reports that outstanding features of the new construction work were the ease in making joints and the speed of laying the line. When completed and tested no leaks were found. Performance of the original Dresser-coupled line from the Sam Fordyce field to Port Isabel has been extremely satisfactory to date, Hensley adds.

Two bolt men in foreground just behind the laying gang. This gang is capable of three miles a day with Dresser couplings. They were hindered from making time because of slow ditching and break-downs



Section ready to be lowered in. Right-of-way was cut and cleared by Caterpillar "Bull dozer," which takes out trees 2 ft. in diameter with ease

Laying gang setting one in. Note Dresser coupling on end of pipe ready for next joint to be stabbed

Running Tour
WITH MEN IN THE INDUSTRY

P. S. HAURY, petroleum engineer, has moved his office from 609 Wilson Building, Dallas, Texas, to 707 Santa Fe Building, Dallas.

MICHAEL SMIRNOFF, consulting geologist, died unexpectedly at his home in Houston, Texas, on November 23. Smirnoff began his career as a member of the Russian Imperial Guard. Following participation in the World War, the Russian Revolution, and a period in the British army, he came to the United States. In 1923 he graduated from the Colorado School of Mines. Subsequently he was on the staff of the old Roxana Petroleum Company and the Southern Crude Company. When the latter was absorbed by the Standard Oil Co. of New Jersey Smirnoff took up consulting work.

MICHAEL SMIRNOFF

C. A. MOON has been added to the development and production staff of Deutsche-Vacuum Oil A.-G. in Hamburg, Germany. He formerly was field manager in Trinidad for the Trinidad Petroleum Development Company, Ltd.

BYRON B. BOATRIGHT, until recently head of the Petroleum Engineering Department of the Colorado School of Mines, is a new member of the firm of Parker, Foran and Knode, consulting petroleum engineers, Austin, Texas. The company now is known as Parker, Foran, Knode and Boatright. A branch office will be opened in Houston the first of the year with Boatright in charge.

DON TILLEY, pipe line foreman of the Mene Grande Oil Company, returned to Maracaibo, Venezuela, early in December following a three months' vacation in the United States.

H. E. POTTER, assistant division petroleum engineer of the Humble Oil and Refining Company, East Texas Division, has been made division petroleum engineer.

JAMES FOLEY, division engineer in the Rocky Mountain area for The Texas Company, is to be transferred to Bahrein Island in the Persian Gulf. There he will be chief engineer for the California-Texas Oil Co., Ltd.

BEN STEINCAMP has been made production superintendent of the Shell Oil Corporation with headquarters in Fort Worth, Texas, succeeding **FRITZ OLSON,** who has been transferred to Drumright, Oklahoma.

WILLIAM MULLEMEISTER, manager of the Houston, Texas, refinery of the Shell Petroleum Corporation, on January 1, will return to the St. Louis headquarters to become head of the products division. **DR. R. H. WASER** will take over Mullemeister's work at Houston. He has been in charge of the Wood River plant. **F. S. CLULOW,** manager of the East Chicago refinery, has taken over Dr. Waser's duties at Wood River. **T. G. ELDER,** superintendent of the Houston refinery, has been appointed refinery manager at East Chicago, and **J. L. MILLER** has been made manager at Houston. **F. C. CUTTING,** who has been at Wood River, has been appointed superintendent of the East Chicago refinery.

J. L. STEPHENS, of Chanslor-Canfield Midway Oil Company, has been promoted from district engineer in the Kern River district of California to division engineer in the San Joaquin Valley. His office is at Fellows, California.

W. J. HALEY, assistant to **G. W. GORDON,** the director in New York of European refinery construction and operation of the Standard Oil Company of New Jersey, recently returned to the United States following a business trip to the London, England, office of the company.

FRANK S. HORNE, superintendent of the Barnsdall Oil Corporation's refinery at Wichita, Kansas, has been transferred to Barnsdall, Oklahoma, and placed in charge of the plant there. He exchanges positions with **V. R. OAKLEY.**

J. R. PARKER has been made manager of the branch office opened at Olney, Illinois, by the Gulf Refining Company. State production headquarters for the Gulf are at Mattoon.

M. L. MAYFIELD, of the Empire Companies, following a year in the New York office, has been assigned to production engineering duties in the East Texas field under **R. H. MAPLES.**

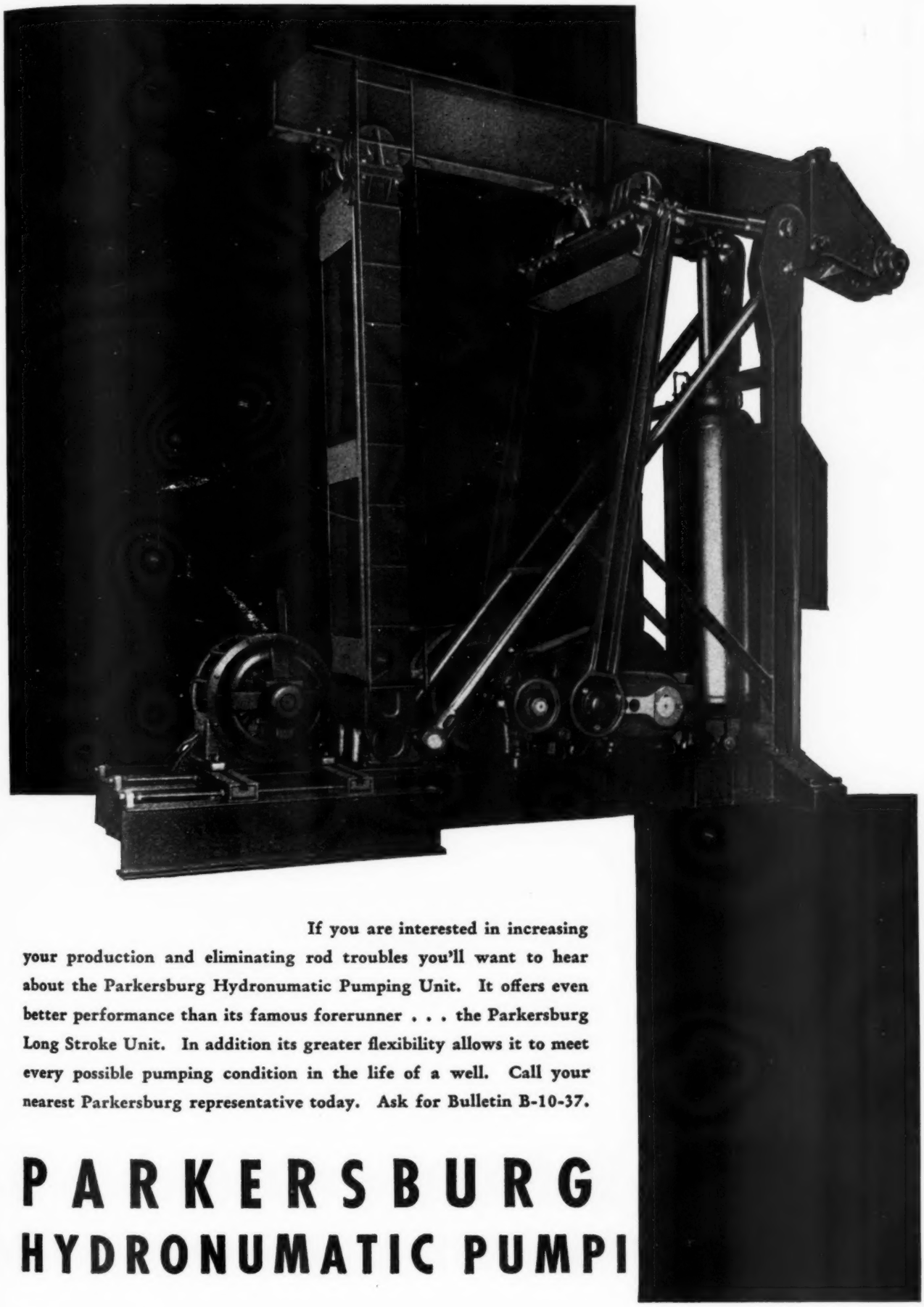
W. H. YOUNG, JR., formerly manager of the Oil Core Testing Laboratory, Inc., Titusville, Pennsylvania, has joined the staff of the Bradley Producing Company, Wellsville, N. Y., as petroleum engineer and geologist.

R. E. "BOB" FREVERT has been made chief clerk of oil production for the Oklahoma division of the Empire Companies, with headquarters in Bartlesville. He was transferred from Seminole where he held the position of district chief production clerk. **JACK J. DILLON** succeeds Frevert at Seminole.

H. F. ABRAMS, technical manager of overseas refinery construction and operations of Socony-Vacuum Oil Company, Inc., has returned to New York City following a business trip to Europe.

GEORGE VINES, general production superintendent of the Creditul Minier S. A. R., Bucharest, Rumania, who has been visiting the Texas, Oklahoma, and California fields, sailed for home recently.

STARR THAYER, who for seven years has been corrosion engineer for the United Gas System, Houston, Texas, has opened an office in the Rusk Building to do general consulting work. He also will act as consultant for the United and affiliated companies.



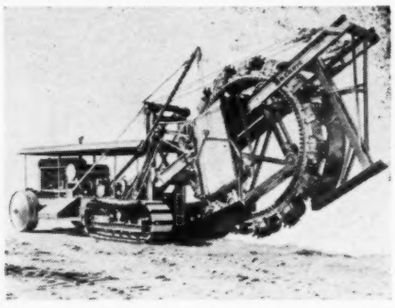
If you are interested in increasing your production and eliminating rod troubles you'll want to hear about the Parkersburg Hydronumatic Pumping Unit. It offers even better performance than its famous forerunner . . . the Parkersburg Long Stroke Unit. In addition its greater flexibility allows it to meet every possible pumping condition in the life of a well. Call your nearest Parkersburg representative today. Ask for Bulletin B-10-37.

PARKERSBURG
HYDRONUMATIC PUMPI

MACHINERY and EQUIPMENT

Buckeye's Model 49 Ditcher

ANNOUNCEMENT by the Buckeye Traction Ditcher Company of Findlay, Ohio, of a new, large-size, wheel-type ditcher with a capacity for digging trench from 21 to 42 in. wide and up to eight ft. deep, is attracting considerable attention among users of ditching equipment. Two features are of particular interest. It has the largest digging capacity of any of the pipe line wheel-type ditchers, its manufacturers state; its unusual range of trench width running from the moderate size trench of the average pipe line up to



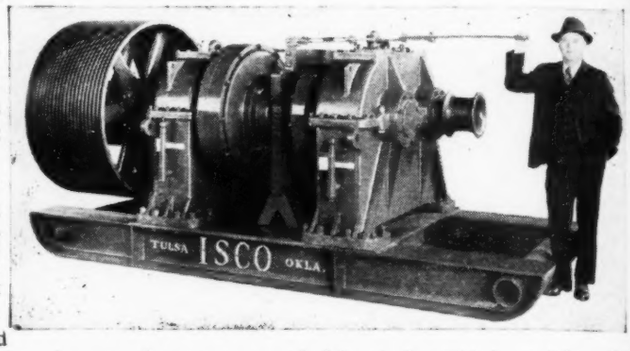
the largest ordinarily required under any circumstances. The other feature that is expected to cut maintenance time and speed operation is the use of all transmission drives. All controls are conveniently grouped at the operator's platform and a change of speed for any operation is as easily made as shifting gears on an automobile. Independent drive for the traction wheels permits shift in traction speed without stopping the digging wheel.

Hydraulic steering gives instantaneous, accurate, and easy control of the movement of the machine at all times, it is stated. Individually controlled contracting band brakes provide for safe handling on any practical grade, with equal braking force effective in either direction. Positive ratchet locks in each alligator wheel prevent the machine rolling back when the crawler drive is disengaged.

The ample size of the alligator traction wheels brings the bearing pressure down to less than ten lb. per sq. inch. A worm-driven winch mounted on the front of the main frame is offered as additional equipment. Speeds at which this winch is driven are synchronized with the high range digging feeds, permitting the use of the winch as a snub for hillside operation.

Isco Reverse Clutch

CLAIMING features that include maximum capacity, minimum upkeep, greater ease of operation, and freedom from repairs, International Supply Company, Tulsa, Oklahoma, announced their new Isco Reverse Clutch which, they say under field tests has established an unusual record. An advantage for this new unit is its smoothness and ease of operation that the manufacturers claim is attributable to the fact that the inertia of moving parts that change direction of rotation during reversing operation is much less than on conventional old-style clutches. This is further aided by the roller bearing mounting of the operating lever.



The Isco Reverse Clutch is of welded construction with heavy, structural-steel base, semi-steel ribbed cases, hammer-forged SAE chrome-nickel roller bearing steel shafts, and cast SAE alloy-steel herringbone gears. The forward drive is by 2½-in. triple roller chain. It has only one light-weight double cam, limited movement, adjustable friction plates, bayonet-type gauges for checking oil level, and oil-bath lubrication of all moving parts. Sprockets are cut-tooth forged steel, reverse and neutral positions are pivoted on ball bearings. Operating lever and clutch yoke are Alemite lubricated. There is a single forward lever control.

Electrode for Welding with Small A-C. Transformer Welders

A NEW mild steel arc-welding electrode, designed particularly for use with small a-c. transformer type arc-welders, said to simplify welding with this type of equipment and provide weld metal of high quality, is announced by The Lincoln Electric Company, Cleveland, Ohio.

The new electrode, designated "Transweld," is the result of extensive research on the part of Lincoln engineers to develop a rod that would meet the special requirements of small a-c. transformer welders.

"Transweld" has a very heavy extruded coating and, the manufacturers state, unlike ordinary electrodes used with small a-c. welders, has a very stable arc, easy to strike and hold. Because of its stable arc the electrode permits making welds in smooth well-shaped beads. Another advantage is in regard to slag removal. Slag is easily removed from "Transweld" deposits, it is stated.

Weld metal produced by the electrode possesses high physical properties. Tensile strength is 75,000 to 85,000 lb. per sq. in., yield point 60,000 to 68,000 lb. per sq. in., and ductility 20 to 30 percent elongation in two inches.

"Transweld" is suitable for making all types of welds in flat, horizontal, vertical, or overhead position. The electrode operates equally well with d. c. of either straight or reversed polarity.

"Transweld" is made in three sizes: $\frac{3}{32}$-, ⅛-, and $\frac{5}{32}$-inch. The smaller size comes in 12-in. lengths, the other two in 14-inch.

† "THE WATCHER OF THE PLAINS"—by Charles M. Russell

The Watcher of the Plains

The price of success is vigilance. He who would best serve his patron and himself is watchful of today—visionary of tomorrow. ☆ In every industry are companies whose watchfulness is expressed in building products of highest quality—in keeping abreast of every progressive change that will affect their customers' interest. Even as the lone sentinel of the plains kept unceasing vigilance against lurking dangers, so do these companies watch to see that in dollar value, in service and in performance their products are unexcelled. ☆ Such a company is Axelson, backed by forty-five years of vigilance. ☆ Axelson Manufacturing Company, P. O. Box 98, Vernon Station, Los Angeles. St. Louis. 50 Church Street, New York. Tulsa. Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation. Rocky Mountain Distributor: Great Northern Tool & Supply Company.

☆ ☆ ☆

† Charles M. Russell knew and loved the great West. In his bronze, "The Watcher of the Plains", he has portrayed a Blackfoot scout, Son of Sleeping Thunder, and an old friend. Seated on high country, his keen eyes catch every unusual thing that appears. He warns his people against danger from the White Man or beasts of prey. This is the first time that permission has been granted for reproduction of this bronze. A reproduction of this picture, suitable for framing, is available upon request.

AXELSON PUMPS AND SUCKER RODS

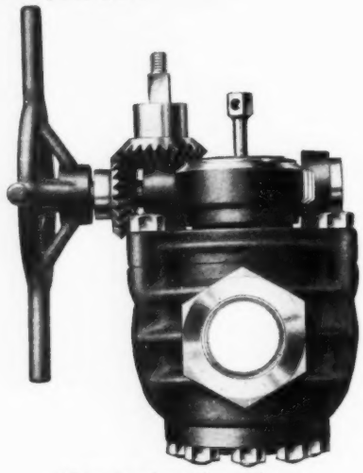
Newman-Milliken Glandless Lubricated Plug Valves

NEWMAN, Hender and Company, Ltd., Woodchester, England, has greatly extended the range of its line of Newman-Milliken glandless lubricated plug valves, particularly those suited for the highest operating pressures. These valves are used in the handling of various petroleum products, as well as water, steam, boiler blow-off, air, vacuum, gas, chemicals, etc., and are made of ferrous metals for non-corrosive services and of various alloys for corrosive services.

Accompanying illustrations are of the round port type, series 3000. The body and bottom cover of these valves are made from high-grade steel castings having a tensile strength of 35-40 tons per sq. inch. These are carefully annealed to relieve the material of all casting stresses. The plug is made of Newmiloy metal for non-corrosive services and can be coated with stainless steel, aluminum, nickel, etc., for corrosive services.

The lubricant set screw, balls, and ball seat are made of mild steel. The plug support and ball check springs are made of special oil-tempered steel. Double ball checks are fitted.

Screwed instead of bolted bottom covers are fitted to ½-in. to 1½-in. valves, inclusive.



View showing full round port

The ports of the valves are fully machined so that when open they offer even less resistance to the flow than the pipe line itself, the manufacturers state.

Prior to shipment the valves are tested first with petrol at 400-lb. pressure to assure perfect machining. Subsequently a hydraulic test is made at twice the rated working pressure, i.e., 6000 lb. per sq. inch. The valves are recommended by the manufacturer for temperatures up to 365 deg. fahrenheit.

Newman, Hender and Company, Ltd., hold the world license for the manufacture of Newman-Milliken valves except for the United States. Milliken valves are manufactured and sold in the United States under license by the American Car and Foundry Company, Ltd.

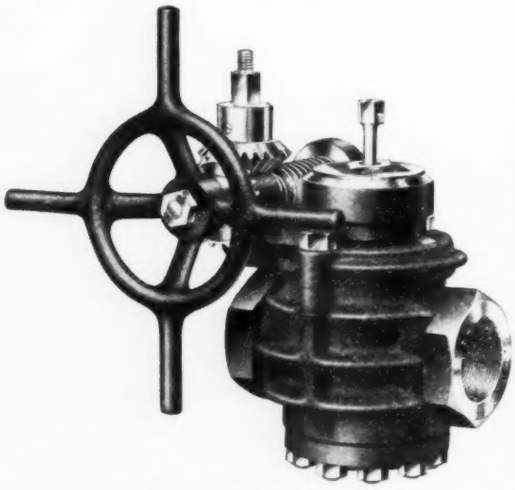


Fig. No. 3000 RG Screwed

Super Rough Rider Asbestos Cord Steam Hose

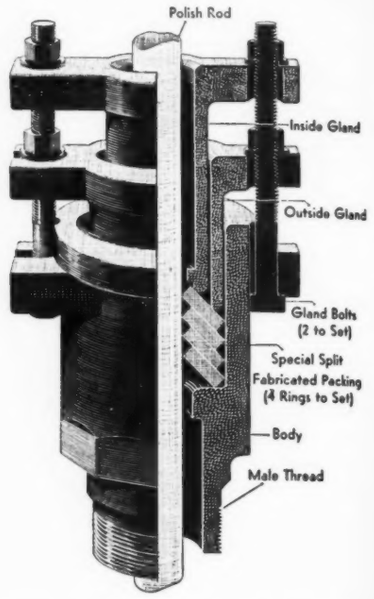
FIGHTING fire in refineries, thawing out oil lines or steaming out cars of asphalt becomes an easy task with the new Super Rough Rider Asbestos Cord Steam Hose announced as a new addition to the line of The Continental Supply Company, Dallas, Texas, oil field distributors for The Mechanical Rubber Company.

Tests conducted in oil refineries where this new hose will find its most important uses, prove it to be easily handled and highly serviceable, the manufacturers state. Adaptability for super-heated, high-pressure steam service, its light weight and high flexibility, combined with rugged construction, make this hose an unusual product, it is pointed out.

Constructed of a high-quality steam- and heat-resisting rubber tube, the hose has four plies of high-strength asbestos cord wound spirally in alternating directions. The cords are cushioned in a layer of rubber and also are wrapped in a heat-resisting rubber cover. It will withstand pressures of 200 lb. per sq. inch. Super Rough Rider Asbestos Steam Hose is made four ply, in ½-in., ¾-in., 1-in., 1¼-in., and 1½-in., I.D. sizes. Maximum lengths are 50 feet.

Improved Polish Rod Stuffing Box

THE Hercules Duplex Polish Rod Stuffing Box is a recent addition to the line of patented oil-well specialties manufactured by Hercules Tool Company, Kennedy Building, Tulsa, Oklahoma. This new box has one inner



gland, one outer gland, and four packing rings of a special fabrication. Packing is adjusted by two bolts that hold glands in place.

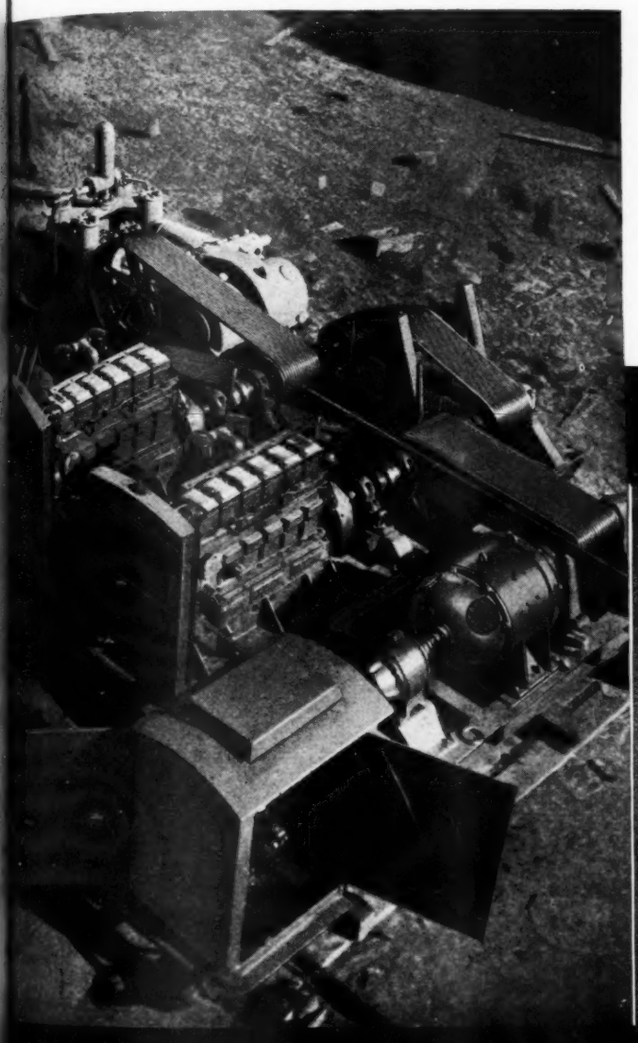
The special packing will last from three to six months on wells where the conventional-type stuffing box must be repacked every few days, the manufacturers claim. At the time of installation, only the edge of the packing will contact polish rod (see illustration). Soon, however, the contacting edges of the packing rings wear down, permitting the entire thickness of the packing to contact the rod, forming a perfect seal and lasting indefinitely. The packing polishes and glazes the polish rod regardless of the condition of its surface.

Because the packing follows the polish rod in its travel from a perpendicular line, this box needs no "wabbler." Packing won't burn out on wells periodically pumping off, as it absorbs enough oil to permit adequate lubrication of polish rod while no fluid is being lifted, it is stated. A perfect pack is obtained regardless of the size of the polish rod used or the length and frequency of the strokes, it is said. The Hercules Polish Rod Stuffing Box will not leak, and is made in all sizes. The manufacturer will supply additional information.

THREE TYPES OF DRILLING RIGS TO SUIT YOUR NEEDS

Type EM ELECTRICAL-MECHANICAL OIL WELL DRILLING RIG

The *All-Electric Rig* . . . the *Electrical-Mechanical Rig* . . . or the *Texrope Driven Mechanical Rig* . . . each has its adherents, each works best in some fields. Allis-Chalmers, the pioneer in d-c electric drilling, is the only company building *all three* and can give you an unbiased recommendation as to the proper rig.



Type EM, Electric-Mechanical Rigs, are a combination of a straight mechanical rig with electrical equipment added to drive a hoist and rotation motor instead of a reverse clutch as used with full mechanical rigs. With a direct current generator and motor substituted for reverse clutch, the excellent torque characteristics of direct current are available for hoisting as well as the extremely fine and flexible speed control of the Ward Leonard System.

This type rig is built in three sizes and for either two or three engine operation with provision for driving one or two slush pumps.

The necessary variation in pump speed is accomplished by change in engine speed, by throttle or governor control.

Electrical equipment supplied with Type EM rigs is arranged to maintain full voltage over the speed range necessary for slush pump operation.

All three types of rotary drilling rigs are described in Bulletin 163. Get a copy from your supply company.

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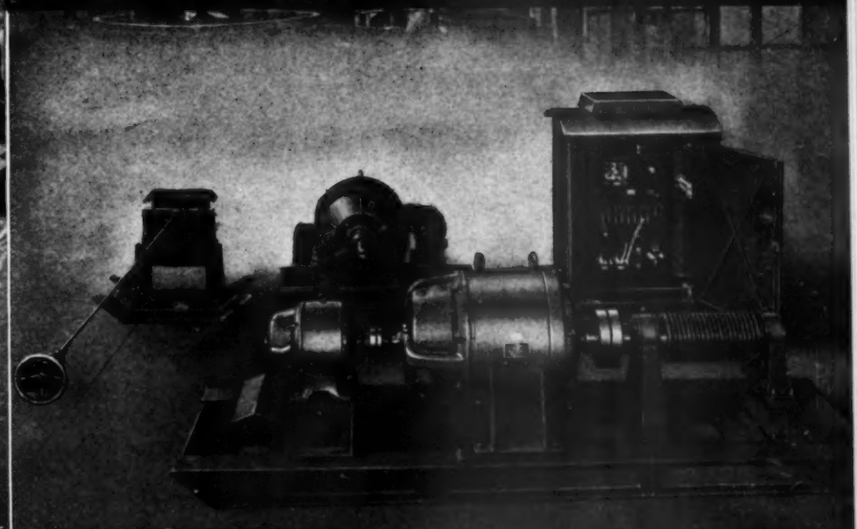
Left — Type EM2 Rig being set up on location

Below — Shop view of Electrical Equipment for an EM2 Rig



EQUIPMENT ENGINEERS TO INDUSTRY

ALLIS·CHALMERS

MILWAUKEE WISCONSIN

Cable Tool Underreamer

AN ECCENTRIC type of cable tool underreamer known as the BJ Underreamer Drilling Bit has been announced by Byron Jackson Company, 2105 East Slauson Avenue, Los Angeles, California. This tool has been designed to make fast, straight, vertical full-gauge hole while carrying the casing and at the same time underream the hole to a diameter large enough for the casing to be lowered and moved freely. The casing can be carried close behind the bit in all types of formation—only a few feet of open hole need be present at any time—and the conventional underreamer is not required, the manufacturers state.

This tool consists of a pilot bit above which is an eccentric reamer cutter and stabilizer. The design conforms to that of the new BJ straight hole cable tool bit with the reamer made an integral part of the bit so that there are no joints and no expanding or detachable parts. The small-diameter pilot bit is longer than the normal drilling stroke and acts as a straight-hole guide.

The eccentric cutter and stabilizer permits the tool to be run through the casing, and yet cut a hole of larger diameter than the casing.

Because of the eccentric position of the stabilizer, the tool is provided with another shorter stabilizing cutter. In operation, as the short stabilizer enters the top of the pilot hole, the bit is brought to a true, vertical position for its entire length, so that the eccentric cutter and stabilizer cuts the formation to the desired diameter.

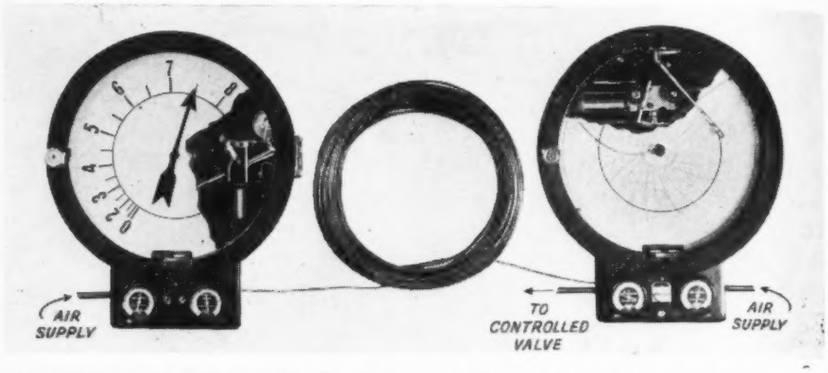
The Underreamer Drilling Bit is made in 16 sizes for casing ranging from 6⅝ in. to 18⅝ in. A.P.I. size. The diameter of the underreamed hole made is from 8 1/16 in. to 23 in. with size of pilot bit from 3⅜ in. to 12 inches. The length of the pilot bit is six ft. for tools to run through 6⅝-in. and 7-in. casing; eight ft. for 8-in. to 9⅝-in. casing; nine ft. for 10¾-in. and 11¾-in. casing; and ten ft. for all larger sizes.

Brown Pneumatic Transmission System

PNEUMATIC Remote Transmission of Measurement is the latest process control development pioneered by The Brown Instrument Company, Philadelphia, Pennsylvania. It is entirely new—yet a safe and dependable system—designed primarily for remote measurement of process variables in atmospheres containing explosive gases, where electrical measurement is not permissible, the makers state.

The Brown Pneumatic Remote Transmission System consists essentially of a transmitting indicating instrument at the point of operation and a receiver that may be an indicator or recorder situated at the remote master control board.

The remote transmission unit is a simple, balanced air pilot, mechanically actuated, built into the indicating transmitter. The receiver is either an indicating or recording pressure gauge, calibrated in terms of the variables being measured.



Complete assembly of Pneumatic Flow Transmitting System. Left—Indicating flow transmitter. Center—Transmission tubing. Right—Recording and controlling flow receiver.

Not only does Brown pneumatic transmission provide a safe and reliable means of transmitting measurement from the point of operation to a central control house, but it also provides an indicator at the point of measurement, the manufacturers state.

Sprayable Corrosion-Resistant Plastic Material

AS an easy, economical way to stem the destruction of concrete, steel, and wooden structures and equipment by corrosion, erosion, electrolysis, etc., American Concrete and Steel Pipe Company, Box 1428, Arcade Station, Los Angeles, California, have developed and now are offering to industry "Amercoat," a sprayable corrosion-resistant plastic.

Dilute (and up to 20 percent concentrated) solutions of sulphuric, hydrochloric, nitric, acetic, hydrofluoric, and other acids, caustics of all types, gasoline, oils, greases, hydrogen sulphide gas and many other kinds of corrosive agencies have no apparent effect upon Amercoat within a temperature range of minus 50 deg. to 150 deg. fahr., it is claimed.

In addition to its inertness to corrosive agencies, Amercoat actually bonds to the base material whether it be concrete, steel, or wood. It cannot be peeled or readily chipped off and, even after it is applied and allowed to harden, vibration or limited bending will not check, crack or break it, it is stated.

As it may be sprayed on with paint-spray apparatus, Amercoat offers no application obstacles. Normally, it is applied to a thickness of 1/64 in., but a coating of any desired thickness from 1/100 in. to 1/16 in. may be sprayed on. It is efficient and effective whether applied in a thin or a thick coating, it is stated.

Naturally colorless, Amercoat may be pigmentized to practically any color or shade to blend with its surroundings, thus serving as an ornamental covering as well as a corrosive-resistant protection for structures and equipment.

Although Amercoat is not designed to resist abrasion as well as corrosion, it is a synthetic plastic that has the necessary strength and resiliency to give it considerable resistance to the abrasive action of solids or liquids that may come in contact with it. Amercoat has a tensile strength of more

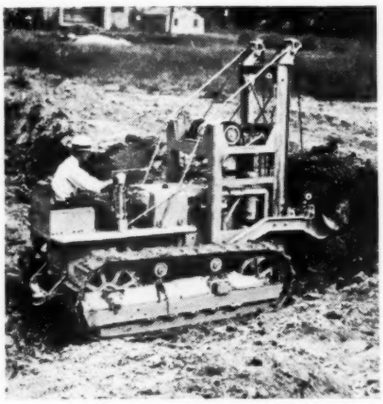
than 200 lb. per sq. in. and a smooth semi-glazed surface. Its abrasion-resistant properties are quite comparable to those of rubber, bakelite, and similar substances, the manufacturers state.

Amercoat is a nonconductor of electrical current.

The Amercoat protective covering actually is composed of three separate solutions, comprising a prime coat, an enamel, and a seal coat. Each separate solution, however, is quick drying and the coatings are applied one after another so that the application procedure may be considered a continuous one.

Trackson High Shovel

THE Trackson High Shovel is now available on "Caterpillar" tractors R4 and D4. This heavy-duty digger and loader is useful every day of the year around wells, tank farms, and refineries, and on pipe line construction and maintenance. It will excavate in clay, gumbo, or rocky soil, dig slush pits, erect dikes and levees, do stripping, leveling, and subgrading, remove snow, and transport or load all kinds of bulk materials. The Trackson High Shovel is regularly equipped with a ¾-yard bucket and will dig, move, and load up to 50 cu. yd. an hour.



Advantages claimed for this machine are: a fast mechanical hoist that is not affected by weather temperature; independent front-end drive; free dumping of the bucket at any point of the lift; automatic release when bucket reaches maximum height; full visibility for the driver; and many other features.

The "Caterpillar" Tractors to which this shovel is adapted are specially equipped with wide gauge, extra length (five roller type) rigid track frames, front power take-off, and blower type fan. Further details may be obtained from any "Caterpillar" dealer or from Trackson Company, Milwaukee, Wisconsin.

PURCHASED ELECTRIC POWER

assures

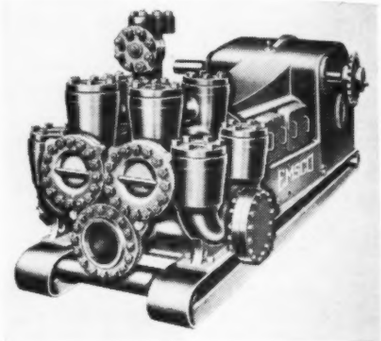
PERFORMANCE · ECONOMY · PRODUCTION

HOUSTON LIGHTING & POWER COMPANY

Emsco Forged-Steel Fabriform Power Slush Pumps

THE Emsco Derrick and Equipment Company, Los Angeles, California, announces the Emsco Forged-Steel Fabriform Power Slush Pumps. The fluid end is fabricated completely from steel forgings electrically welded and is of the direct-flow type. One piece or divided types of fluid ends are available. The power end is fabricated from structural-steel shapes and plates, and cast-alloy steel. The bearing housings for both shafts on each side are machined in a heavy alloy-steel casting, welded integrally with the frame.

An important feature of the new Emsco power slush pumps is the positive system of mud exclusion from the crosshead chamber and crank case, the manufacturers state. The frame barrels are divided into compartments by forward and after partitions. The former is demountable and carries a renewable rubber bushing that closely fits the piston rod. Water flushing pipes keep the rod clear of any mud escaping from the fluid stuffing box. The after partition carries the demountable stuffing box for the crosshead extension rod and seals the forward end of the crosshead chamber against foreign matter. The heavy crosshead extension rod receives the fluid piston rod and permits the use of a short, less expensive rod. A steel and rubber baffle plate at the junction of the rods forms an additional obstruction to the entrance of mud. A sump at the after end of each crosshead chamber definitely stops



the entrance of any foreign matter into the gear case, either coming from the fluid end or from the oil filler opening, it is stated.

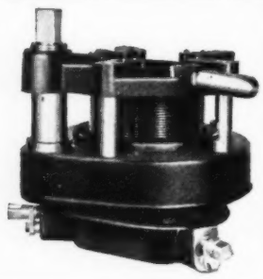
Effective power transmission is provided by the pinion shaft, which transmits a maximum of 300 hp. through 12-in. face herringbone gears to the main shaft. The pinion shaft is extended on both sides for prime mover pulley or sprocket, permitting power to be applied from either side. Eccentric-type cranks of new design are fitted with one-piece bronze liners and the crosshead bearings are of needle-type roller construction. The entire gear and crank assembly is readily demountable from the frame without withdrawal of the main shaft.

Constructed to withstand 6000-lb. actual test pressure, these pumps are recommended for 3000-lb. working pressure with 300-hp. input rating.

One-Piece Drill-Pipe Elevator

A ONE-PIECE drill-pipe elevator with no hinges and featuring a fast-opening door of unusual design has been developed by the Vaughn Oil Tool Company of Huntington Park, California. The Vaughn elevator carries the entire weight of the string on one solid piece of steel. There is no stress on the door and no uneven distribution of weight. The elevator is made of 4140 heat-treated alloy steel pretested to stand stresses of 110,000 lb. per sq. inch.

Another feature is the built-in door that moves in a fixed, circular channel within the collar of the elevator. A bullet-shaped latch, impelled by a jam nut and spring, drops into a hole when the door is closed. Perfect line contact



NO BETTER 4″ THREADER

...than a "TOLEDO" No. 2BR 2½" to 4" capacity

A separate set of dies for each size assures smooth, standard taper threads and ease of operation.

No bushings. Three broad-faced chuck jaws with size marked guide bars operated by heavy set screws make for easy accurate centering. Minimum wear. Long life.

Operated by hand with ratchet handle furnished or by Power Drive or with Pipe Machine and Universal Shaft.

Specify a "TOLEDO" No. 2BR for your next job.

THE TOLEDO PIPE THREADING MACHINE CO.

TOLEDO, OHIO — New York Office, 72 Lafayette Street

A "TOLEDO" No. 2BR can be taken right to the job and the work performed with ease.

"TOLEDO"

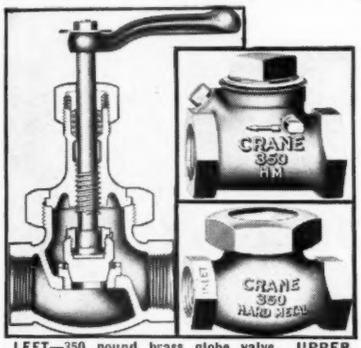
between door and pipe insures maximum safety at all times, even though the door should be only partly closed, the manufacturers state.

The simplicity of design and operation of the Vaughn elevator is said to increase the speed of getting strings in and out of holes, to afford unusual ease of operation, to provide utmost safety for the man on the rig, and to give strength and endurance far in excess of even extreme demands.

Literature and prices may be had by writing the Vaughn Oil Tool Company, 6220 Templeton Street, Huntington Park, California.

Valves by Crane Co.

A NEW line of brass screwed end globe and check valves for 350-lb. steam pressure at temperature of 550 deg. fahr. is being offered by Crane Company, Chicago, Illinois. These valves are designed especially for high-pressure steam lines such as are used on oil and gas field boilers for deep-well drilling operations. They also may be used on non-shock cold water, oil or gas lines for pressures up

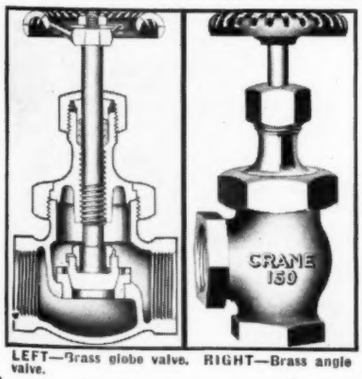


LEFT—350 pound brass globe valve. UPPER RIGHT—350 pound brass swing check valve. LOWER RIGHT—350 pound brass lift check valve.

to 1000 pounds. Their sizes range from ½ in. to 2 inches.

The globe pattern brass valve (62-P) is of the union bonnet design (except the 2 in., which has a bolted bonnet) and has Crane nickel-alloy plug-type disk and Exelloy body seat ring.

The horizontal lift check valve also



LEFT—Brass globe valve. RIGHT—Brass angle valve.

has a union bonnet except the 2 in., which has a bolted cap. Disks are of the piston-guided type and seats are renewable screwed-in rings of Crane nickel alloy. The horizontal swing check valve (No. 78-E), which may be used either for horizontal or upward flow, has screwed cap and tapped hole in the body to facilitate regrinding of the disk.

In order to have a companion line of brass gate valves for this same service, a 350-lb. steam rating at 550 deg. fahr. has been added to the regular Crane No. 230-H brass gate valves.

For severe service on small lines carrying steam, hot water, cold water, oil, gas, and similar fluids, Crane Company is offering a line of brass globe (No. 14-½-P) and angle (No. 16-½-P) valves with plug-type disk of Crane nickel alloy and body seat ring made of Exelloy.

Made in sizes ⅛-in. to 3 in., these valves are recommended for 150-lb. steam working pressure and 300 lb. on cold water, oil or gas lines. Their wide seat bearing is unusually resistant to wire drawing and foreign matter, and their tapered disk permits easy flow regulation when throttling.

These valves are similar to the Crane 14-P and 16-P brass valves.

Q. What is the cost of a string of cable tools?

A. The value of the service rendered by the tools.

THE value of a set of cable tools is not determined by the initial cost. It's what you get for your money that counts.

Measured by this yardstick, Spang Cable Tools are the most economical tools you can use. Every cent of your investment is doubly returned in strength, efficiency and length of service.

Refer your cable-tool problems to Spang & Company, and put our extensive experience to your own use.

SPANG & COMPANY
BUTLER, PENNSYLVANIA

PROSSER-TYPE ROPE SOCKET
Fig. 505

Specify Spang
"HIGHER-STANDARD" CABLE TOOLS

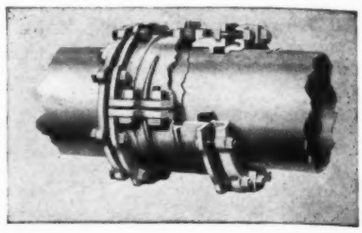
Repair Sleeves for Winter Pipe Breaks

DURING the winter months breaks in pipe lines are of a more serious nature because of the greater difficulty in making repairs during sub-zero temperatures. Also, in the case of gas lines, it is the season when service is most in demand. Repair sleeves, which the makers say can be installed quickly, are manufactured by the S. R. Dresser Manufacturing Company, Bradford, Pennsylvania, for such emergencies.

According to the makers, these sleeves permit full or partial service while the repair is being made; can be installed under any weather or ditch conditions—even under water; are easy to handle because they are cast from light-weight, high-strength metals; require only a wrench and a few minutes to install; and provide flexibility to prevent repetition of the break. Another advantage claimed is that the repair is permanent and need never be re-made.

For enclosing breaks and holes up to 8 in. long in the straight run of cast-iron pipe, Dresser offers a "Style 57" repair sleeve in sizes from 2 in. to 12 in. C.I.P., inclusive. This type holds a maximum working pressure of 250 lb. per sq. inch. Splits longer than 8 in. can be repaired by joining two or more of the sleeves, says the manufacturer.

Another type of split sleeve—made especially for repairs to broken or split bell-and-spigot joints—is the Dresser "Style 26," which completely encloses the damaged joint.



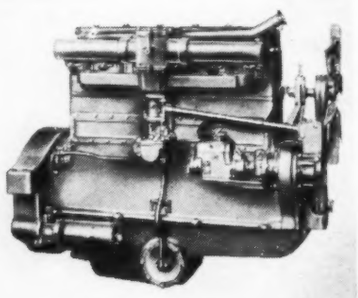
Cutaway view of a popular Dresser Repair Sleeve (Style 57), showing how it encloses and repairs breaks and holes in the straight run of pipe. End and side gaskets are blow-out-proof and made of a special, everlasting rubber compound. Other stock sleeves are available for repairs to pipe and joints.

Steel pipe and joints take a special series of repair sleeves, the three Dresser types being (1) "Style 52A" for enclosing screw collars, circumferential welded joints, and defective pipe, up to a maximum working pressure of 500 lb. per sq. in.; (2) "Style 73" for the same purpose, except for 250-lb. maximum working pressure; and (3) "Style 54A" for enclosing bolted joints of various types up to pressures of 500 lb. per sq. in. or less.

All repair-sleeve orders, the Dresser company adds, are given special, rush attention at this time of the year.

Two New Models Gasoline Engines by Buda

TWO new models of gasoline engines have been announced by the Buda Company, Harvey, Illinois.



These models are known as the M-707 and M-766. They are 6-cylinder engines with overhead valves. The M-707 has 707 cu. in. displacement with a

The Biggest Help Drilling Crews Have Had to Date

The GRIZZLY ROTARY BRAKE BLOCK BAND EXCHANGE

A Bear for Wear

A tremendous aid to drilling crews, the Grizzly "Band Exchange Plan" takes all the grief out of brake relining jobs for draw works; saves time, trouble and uncertainty, and assures better brake performance.

Simply turn in your old, worn, warped bands and receive brand-new steel bands, made exactly to factory specifications and lined with genuine Grizzly Full-Moulded Rotary Brake Blocks of the RIGHT thickness, width, length, and radius for your particular draw works. All for the same money that you ordinarily would pay for lining and installation alone.

Grizzly Rotary Brake Blocks have proved consistently their superiority in holding the load at any depth, smoothness in feeding off, positive brake action at all times, and longer wear.

Ask your nearest supply house for complete details and prices.

E. M. SMITH COMPANY

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Complete Stocks Maintained in Our Warehouses at: 2311 West St., Houston, Texas; 1008 S. E. 29th St., Oklahoma City, Okla. Sold in the Mid-Continent and Gulf Coast by: Continental Supply Co., and T. T. Word Supply Co., Inc., Houston, Texas—In All Their Stores. Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City, New York.

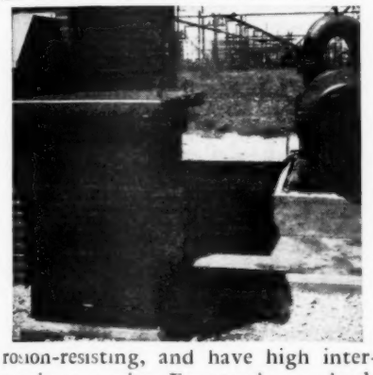
5-in. bore and 6-in. stroke. The M-766 is 5½ in. by 6 in. and has 766 cu. in. displacement.

Crankshafts are 3½ in. in diameter, with seven main bearings, and connecting rods are 12½ in. center-to-center. All crankshaft and connecting rod bearings are the replaceable "precision" type. Lubrication is by positive force-feed pressure to all crankshaft, camshaft, connecting rod and piston pin bearings, and to rocker arm shafts and timing gears.

The M-707 and M-766 are constructed for various types of installations including shovels, cranes, draglines, hoists, heavy-duty trucks, stationary and portable compressors, pavers, crushers, locomotives, and rail cars.

High-Voltage Explosion-Proof Linestarters

DESIGNED primarily to meet the requirements of the petroleum and chemical industries and other hazardous applications, the Westinghouse high-voltage type DNO linestarters are completely oil-immersed and cor-



rosion-resisting, and have high interrupting capacity. For starting squirrel-cage and wound rotor induction motors these linestarters are available for 2200 or 4600 volt service. For three pole, 60, 50, 40, or 25 cycle power their maximum ratings are 700 hp. for 2200 volts and 1250 hp. for 4600 volts

The starter is available either for floor mounting, in which case access may be had to the starter by removing the cover, disconnecting the leads, and lifting the internal assembly out of the tank, or with a structural mounting frame that supports the unit off the floor and provides for lowering the tank away from the internal assembly.

The internal assembly is the same for both the floor-mounted and frame-mounted starters, and consists essentially of the main switch with its operating mechanism and auxiliaries, an operating transformer, current transformers, and overload relays. The starter is operated by a special two-button oil-immersed push-button station.

Being weather-proof also, these linestarters may be mounted outdoors, saving building costs. The high capacity of the starter in many instances results in its being sufficient protection for the feeder circuit without a feeder circuit breaker.

The line switch is of the circuit-breaker type, d-c. solenoid-operated through a rectox effectively sealed off from the outside atmosphere and oil by the diving bell in which it is mounted.

The switch operates under a high head of oil. A time delay undervoltage trip of the capacitor type, having a timing range of 1 to 4 seconds, is used with the main switch. Instantaneous overcurrent trips, transformer operated, provide short circuit protection.

Two-element overload protection is provided by thermal-induction relays of a type specially designed for operation totally immersed in oil and with a very desirable inverse time characteristic for protection of the motor up to and including locked rotor conditions. The relays are adequately protected by the instantaneous trips of the main switch.

TRY AND BEAT THIS LINING FOR WEAR!

THIS RIG, owned by the firm of Golden and Farris, and being used in the Corpus Christi oil fields, Texas, was re-equipped with J-M Giant Rotary Lining, Style 410. The superior, dependable service of this unusually durable material assures continued high braking effectiveness here and on all similar rigs.

You get all these advantages on your drilling rigs—with J-M Lining, Style 410

AN EVEN FEED-OFF
. . . assuring better controlled drilling.

LESS SMOKING AND DUSTING
. . . working conditions greatly improved.

SCORING TENDENCY REDUCED
. . . life of brake rim is lengthened.

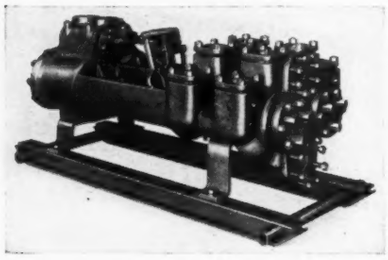
QUIETER BRAKES
. . . less nerve strain on drilling crews.

Johns-Manville
GIANT ROTARY LINING
Style 410

FOR FULL DETAILS on the complete line of J-M Friction Materials, address Johns-Manville, 22 East 40th Street, New York City.

Boiler Feed and Gathering Pump

WORTHINGTON Pump and Machinery Corporation, Harrison, New Jersey, announces the development of a new pump designed specifically for high-pressure boiler feed



and gathering service in the oil fields. This machine is a 10 by 4½ by 10 type "PG" duplex steam pump.

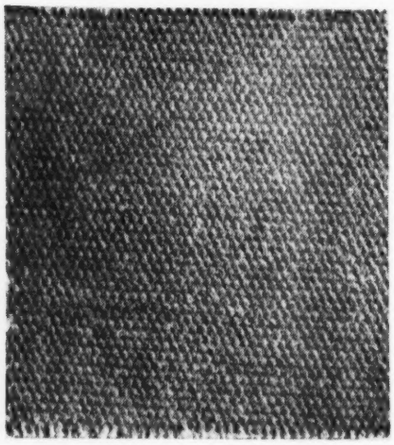
The liquid end of the new unit, conservatively rated for a working pressure of 1000 lb. per sq. in., is of the side pot type. Individual openings are provided over each valve, making them easily accessible.

The steam end features piston steam valves designed for 350-lb. steam pressure. All pressure joints have been eliminated by casting the steam cylinders and steam chest integral.

This equipment is mounted on steel skids to facilitate portability. Ask for Bulletin W-103-B3.

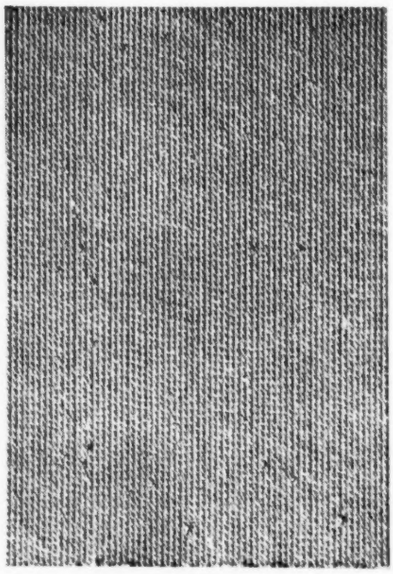
Conveyor Belting Features Cord Construction

THE B. F. Goodrich Company, Akron, Ohio, has announced a new conveyor belting featuring cord construction, said to give considerably longer wear than the best belts of the fabric-carcass type. Whereas conventional conveyor belt design dictates a carcass built up out of plies of woven fabric, Goodrich engineers have developed a construction that substitutes plies of weftless cords such as are used in the modern heavy-duty truck tire, it is stated by the makers. The result is a belt carcass in which every tension member is completely surrounded and insulated with rubber to increase its ability to absorb and withstand shock.



Conventional type of woven fabric commonly used in conveyor belting.

As these cords have no transverse or filler threads obstructing their freedom of movement, they are free to distort themselves. This supplements the cushioning qualities of the cover to such a degree that the belt has unusual resistance to impact, cutting, and gouging, the manufacturers claim.



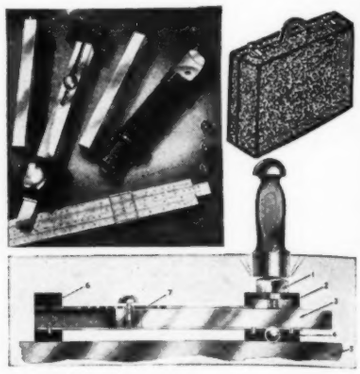
Arrangement of parallel cords in a "weftless" ply of the new Goodrich Cord Conveyor Belt.

Goodrich cord belting is available in any length, width, and number of plies.

Portable Brinell Instrument Tests Metal Hardness

A LIGHT-WEIGHT, portable Brinell instrument that can be carried easily right to the job is said to simplify metal hardness tests in the field, remote from laboratory facilities, and around industrial plants. It eliminates both the necessity of dismantling equipment to be tested and transporting specimens to the laboratory. It is known as the Telebrineller.

In addition to its more obvious uses in many types of plants throughout the metallurgic industries where it is used both in receiving rooms to check deliveries of raw materials with specifications ordered and in routine production control it also has a number of uses in plant maintenance work. It is pointed out, for instance, that it is being used wherever an accurate knowledge of metal hardness is a factor in safety and continuous operation. A number of oil refineries are said to be employing it to test parent metal adjacent to welded joints in alloy-steel pipe in high-pressure and hot-oil lines,

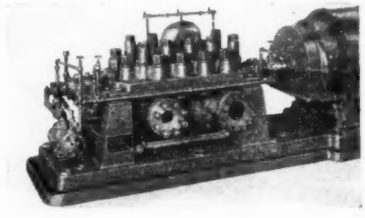


which welding and vibration in use are claimed to harden beyond the safety point, heat exchangers, castings, and other equipment. Tests made at the time of installation and periodically afterward disclose weak points that are annealed in place.

For new literature fully describing the Telebrineller and its use write Teleweld, Inc., Railway Exchange Building, Chicago, Illinois.

"Doubleton" Pump

ALLIS-CHALMERS Manufacturing Company, Milwaukee, Wisconsin, has introduced an improved design of multi-stage pump into the high-pressure pump field. This pump is called the "Doubleton" type because



of the use of double suction impellers, and the double balance of the rotating element. The double suction impellers provide axial balance and the positions of the successive volute passages that surround each impeller are made so as largely to equalize unbalanced radial forces on the impellers. These pumps are made with horizontally split casings for pressures of 1500 lb. and above. The design and bolting has been so worked out, based on the company's experience with bolting high-pressure, high-temperature steam-turbine casings, that no difficulty is experienced in maintaining a tight joint and retaining the advantages of the split casing construction, the manufacturers say. This pump is suitable for high-pressure applications in oil pipe line service as well as for boiler feed service, etc.

Trade Personals

JAS. D. HUGHES, well-known authority on directional drilling who has been active in the management of the Eastman Oil Well Survey Company since its inception in the Gulf Coast several years ago, has resigned as vice-president of this company in order to devote all his time to personal interests.

JACK HOWE, JR., formerly with the Sargent Engineering Company, has moved to Corpus Christi, Texas, to take the Southwest district for the Thornhill-Craver Company, Houston, Texas.

J. E. BRIGGS has been appointed sales representative in West Texas and the Texas Panhandle for the Union Wire Rope Corporation, effective since November 15th. He will make his headquarters at Lubbock, Texas.

W. E. WECHTER has been appointed manager of oil and gas engine sales, Atlantic Division, for the Worthington Pump and Machinery Corporation, Harrison, New Jersey. Wechter succeeds R. L. Howes, recently resigned. He will make his headquarters at the Worthington office, 2 Park Avenue, New York City.

JAMES H. PERKINS, chairman of the board of directors of the National City Bank of New York, has been elected a director of the General Electric Company to fill a vacancy.

J. M. MCNEAL, European sales manager of the Landis Machine Company, Waynesboro, Pennsylvania, has returned to the home office for a visit. McNeal makes his headquarters at Birmingham, England, but also looks after the interests of his company on the Continent.

EDWARD A. CULBERTSON has been made California representative by the American Iron and Machine Works Company, Oklahoma City, Oklahoma. Culbertson has been with the company for the last three years, his headquarters being at Shreveport, Louisiana. His office now will be at 934 N. Alameda, Los Angeles, California.

R. H. GRIFFIN, manufacturing superintendent, and F. M. KEHOE, in charge of research and development at the home office and plant of The Cavins Company, Long Beach, California, are on an extensive business trip through the Mid-Continent fields. They plan to spend some time at each of the Cavins headquarter agencies with a view of thoroughly checking into recent developments of the Cavins hydraulic suction bailer and the Cavins perforation washer in the various oil fields throughout the Mid-Continent territory.

ROBERT H. SCHUSTER has been added to the sales staff of the Pittsburgh office of the Lincoln Electric Company, Cleveland, Ohio. For the last five years he has been employed in sales work in the Pittsburgh district with the Ault and Wilborg Division of Inter-Chemical Corporation.

STRUTHERS-WELLS, Warren, Pennsylvania, have made arrangements whereby GORDON M. JACKSON has become affiliated with the company as New York district manager of the Heat Exchanger Division. His headquarters will be at the company office in the R.C.A. Building, 30 Rockefeller Plaza, New York City.

YOU'LL "COME OUT RIGHT"
On Every Pipe-Line Ditching Job with
..."CLEVELAND Model 110"

"Digs Anywhere ... Anytime" ...
At Least Cost ...

There are reasons why ... Work done at maximum cutting speeds ... Low operating cost ... Maximum machine-digging footage ... Abundant power for toughest work, assuring long life and dependability ... Clean ditch, ready for pipe laying ... Safe, thorough jobs of pipe stripping ... Maximum flexibility.

If you would "come out right" on your ditching costs, simplify your excavation problems and effect money savings put a "CLEVELAND" to work on your next job.

Write for Complete Information Today

THE CLEVELAND TRENCHER COMPANY
20100 St. Clair Ave. Cleveland, Ohio

And again—One Important Cleveland Idea that helps you "come out right" is illustrated at left. High-speed, low-cost transportation via special trailer. "Clevelands" load and unload in 10 to 15 minutes. Thus machine savings are made available even on scattered short lines, "hot-spot" reconditioning, etc.

CLEVELANDS

Link-Belt Personnel Changes

Harold L. Hoefman

George A. Paige

Laurance O. Millard

Paul V. Wheeler

Announcement is made by Link-Belt Company of the following changes in the personnel of its management and sales organization:

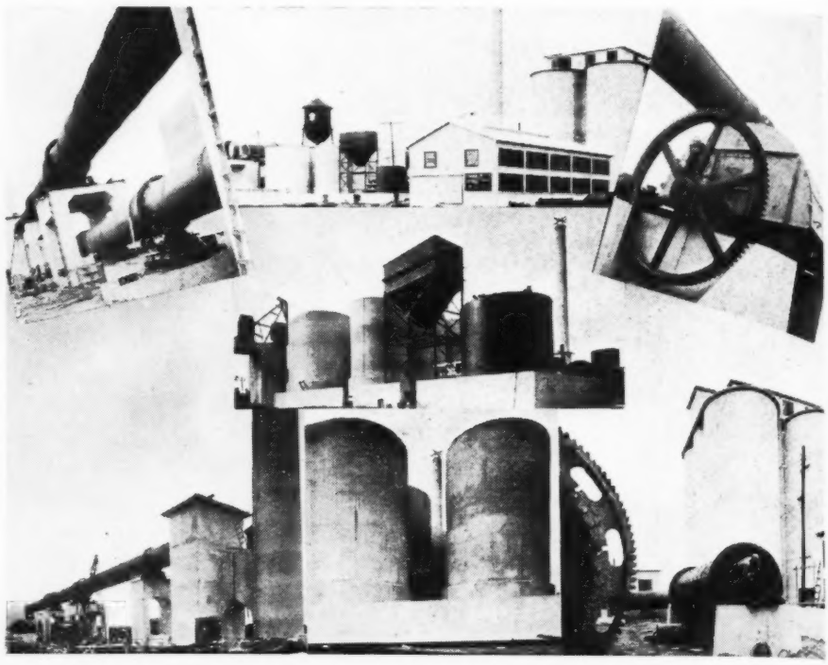
Harold L. Hoefman has been appointed manager of the Link-Belt plant, warehouse, and sales office at Atlanta, Georgia, to succeed I. H. Barbee, who died on November 4. Hoefman brings a wide experience to his new position, having started with the company 17 years ago. Since 1935 he has been manager of the Link-Belt warehouse and sales office in Detroit.

George A. Paige has been appointed manager of the Link-Belt warehouse and sales office in Detroit. Paige also started his Link-Belt career in the Chicago plant engineering department 17 years ago. Since last year he has been district sales manager at Pittsburgh.

Laurance O. Millard has been appointed district sales manager at Pittsburgh. Millard joined the Chicago plant engineering department in 1913. He has been district sales manager at Cleveland since 1933.

Paul V. Wheeler has been appointed district sales manager at Cleveland. He started his Link-Belt career at the company's Pittsburgh office in 1907, and became associated with the Cleveland office in 1921, when the office was first opened, and has been an important factor in its conduct since.

NEW PORTLAND CEMENT PLANT READY IN JANUARY



Top Left—220-ft rotary kiln and rotary cooler below; top center—general view of new plant from ship channel slip; top right—showing installation of newly perfected Kominuter; center—detail view showing installation of lower end of rotary kiln, concrete blending tanks, and shell hopper; lower left—dust chamber, stack and upper section of rotary kiln; lower center—detail view of blending tanks with stack in background; lower right—installation of tube mills used for grinding and pulverizing shell. Giant silos shown in the background

The manufacturing plant of the Gulf Portland Cement Company on Houston (Texas) Ship Channel will be completed and in production shortly after the first of the year, according to announcement by officials of the concern. Started in April, 1937, the plant has given steady employment to more than 85 workmen employed in night and day shifts. Cost of the project is well over half a million dollars.

Construction work is under supervision of the Burrell Engineering Company, consulting engineers and specialists in cement plant construction. The Austin Bridge Company are general contractors.

Kent B. Diehl, president and general manager of the new firm, says: "Not only will Houston's new plant be the only one built in the United States during the present year, but it also will be the most modern cement plant in the world." When completed the plant will have a daily capacity of 3400 sacks of highest grade portland cement. The operating staff will consist of 35 highly trained specialists in cement blending and manufacturing. Diehl has been associated with the cement industry for almost 20 years.

Thomas B. Douglas, technical engineer of the plant, is a graduate of the Virginia Military Institute and formerly was technical engineer for Dewey Portland Cement Company of Kansas City, Missouri. As chief chemist the services of Geoff A. Saeger, formerly chief chemist for Lehigh Portland Cement Company of New Castle, Pennsylvania, have been obtained.

Long Illness Ends in Tulsan's Death

Miss Frances Ruth Snow, for 12 years an employee of the Hercules Tool Company, Tulsa, Oklahoma, died recently at the home of her sister, Mrs. Ed McDonald, at Fort Smith, Arkansas. Miss Snow had been ill for about nine months.

Born in Mansfield, Kentucky, she moved to Keota with her parents when a child. She came to Tulsa in 1925 to work for the Hercules Tool Company and had been connected with them until her illness forced her to retire.

Survivors include her parents, Mr. and Mrs. C. T. Snow of Keota; two sisters, Mrs. McDonald, Fort Smith, and Mrs. Gus Broking, Sebring, Florida; and a brother, W. S. Snow, of Shawnee, Oklahoma.

Harry Cook Manager Houston Office of N.G.E.

HARRY H. COOK

Announcement is made by Natural Gas Equipment, Inc., that Harry H. Cook is now in charge of their Mid-Continent office at 811 Sterling Building, Houston, Texas. Cook's promotion by N.G.E. to managing the Mid-Continent office is coincident with the introduction of the Boilertrol, Natural Gas Equipment's new two-in-one gas fuel and reducing regulator for firing oil-field boilers.

Cook also will be in charge of N.G.E. sales work through their Mid-Continent distributors, Houston Oil Field Material Company, Houston, Texas, and the Webster Engineering Company, Tulsa, Oklahoma.

New Republic Distributors

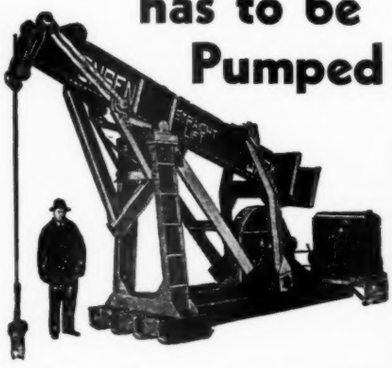
Five new distributors for Republic tubular products have been announced by N. J. Clarke, vice-president in charge of sales of Republic Steel Corporation, Cleveland, Ohio. These include: Bomar Gross, Inc., Jamaica, New York; Drake Supply Company, Los Angeles, California; Iowa Machinery and Supply Company, Des Moines, Iowa; Wilkins Pipe and Supply Company, Peoria, Illinois, and Woodmanse Manufacturing Company, Freeport, Illinois.

R. J. Reed New Manager Titusville Iron Works

R. J. REED

Struthers Wells-Titusville Corporation, Warren and Titusville, Pennsylvania, announce the appointment of R. J. Reed as manager of their Titusville Iron Works Division at Titusville. Reed has been associated with this division for more than ten years. He has been succeeded in his previous position of sales manager by Douglas E. Penning.

If that well has to be Pumped



The difference in pumping units can make a huge difference in what a man ultimately makes out of an oil well.

We'd like to talk with you about that. JENSEN Straight-Lift JACKS, in the opinion of many experienced producers, are the best money can buy.

And since it doesn't cost a thing to investigate, why don't you see your JENSEN dealer now, or

Wire us at COFFEYVILLE!

JENSEN BROTHERS MANUFACTURING CO.

. . . Coffeyville, Kansas

Use this automatic J-M Packing for greater efficiency . . . for lasting protection against costly shutdowns

NO ORDINARY PACKINGS—these Johns-Manville Sea Rings! They not only last longer—but also, they reduce wear on rods—minimize your power requirements.

For Sea Rings are *absolutely automatic!* The flexible lip is held tightly to the rod on the work stroke by the pressure of the liquid, but releases on the return. Result—unnecessary friction is eliminated. And that means less wear on equipment . . . greater savings in power costs.

Then, too, the extra service provided by this long-lasting packing obviates frequent replacements and consequent shutdowns. In every respect, therefore, they are the best packing for reciprocating rods and plungers used in service against oil, steam, hot and cold water, air or brine.

* * *

For full details on Sea Rings, and on the complete J-M line as well, write for our Packings Catalog. Address Johns-Manville, 22 East 40th Street, New York City.

Johns-Manville PACKINGS & GASKETS

Why drill and take a chance of

WHEN YOU CAN
increase present production
WITH A
MILLER

It's expensive business drilling wells, why not first get your maximum production from your present wells? Clean out the sand and sediment that is holding back the oil. The MILLER Sand Pump will do it quickly and at small cost.

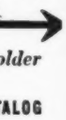
The MILLER is made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9 inches and lengths of 20, 25 and 30 feet. 5/32-inch wall thickness in REGULAR Type, ¼-inch wall tubes HEAVY Type Sand Pumps.

INTERCHANGEABLE BOTTOMS
To Meet Every Condition

● **BAILER BOTTOM**
With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.

● **SAND BOTTOM**
Used when tools are run and when well is shot to quickly remove loose material.

● **STAR BOTTOM**
Used for cutting the sand loose.



● **CHISEL BOTTOM**
(In Pump)
With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

Write for Descriptive Folder and Price List

See Page 1186 COMPOSITE CATALOG

PATENTED
NO. 1370340
NO. 1523696
NO. 1787280
NO. 1862628
NO. 1888818
NO. 2053467

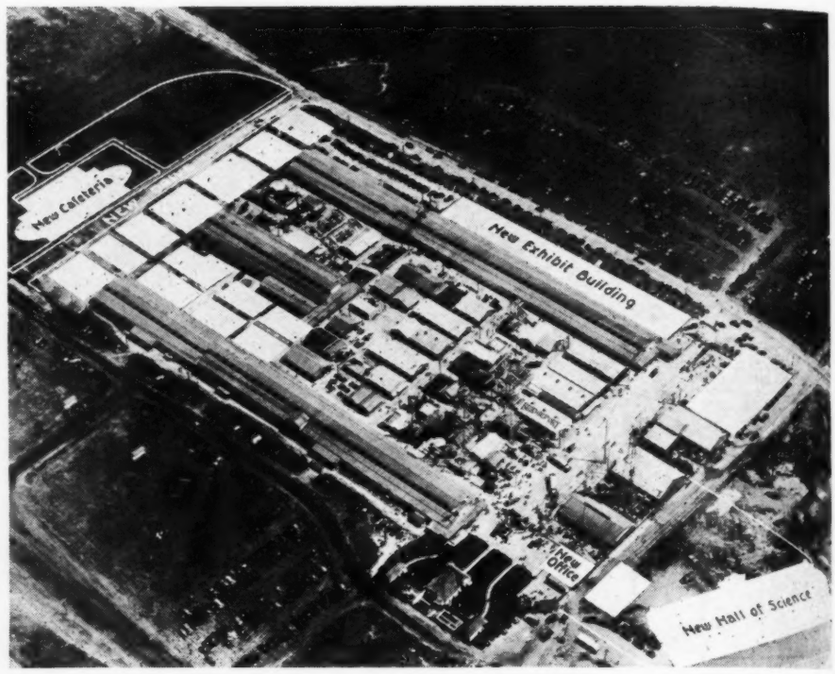
MILLER Sand Pump Co.

General Offices and Shop, Box 4516
OKLAHOMA CITY, OKLA., U. S. A.

Branch Shops and Offices:
SAPULPA, OKLA. and KILGORE, TEX.

FOR SALE BY SUPPLY STORES EVERYWHERE

Progress Made in Plans For International Petroleum Exposition



Aerial view of the International Petroleum Exposition grounds showing new permanent exhibit buildings and new outside exhibit space. The white lines show the extension of the grounds and the white spaces the increased exhibit space

Visitors to the International Petroleum Exposition at Tulsa, Oklahoma, May 14-21, 1938, will find two huge new permanent buildings, the Hall of Science and the Exhibit building, a new hard-surfaced drive, addition of 120,000 sq. ft. of outside exhibit space, and a modernistic cafeteria.

Work on the new drive and the outside exhibit space will start January 1. Through the addition of five acres to the Exposition grounds the total area has been increased to 300,000 sq. feet. The outside exhibits will occupy approximately 40 percent of this area, an increase of 20 to 25 percent over that available for the last Exposition.

The new exhibit building is rapidly nearing completion, as is the new Hall of Science building, and the cafeteria.

Permanent exhibit buildings soon are to be erected by the Oil Well Supply Company, Bovaird Supply Company, Hinderliter Tool Company, Gaso Pump and Burner Manufacturing Company, The Petroleum Engineer Publishing Company, W. C. Norris, Manufacturer, Inc., International Harvester Company, and the Halliburton Oil Well Cementing Company.

The "Old Timer" committee in charge of selecting the "Grand Old Man of the Petroleum Industry" and "Grand Old Man of Tulsa," is being organized with H. R. Gruber, vice-president and sales manager of the Union Wire Rope Corporation, as chairman.

Dr. Leslie With Blaw-Knox

DR. E. H. LESLIE

Dr. E. H. Leslie, authority on chemical process industries, has joined the technical staff of the Blaw - Knox Company, Pittsburgh, Pennsylvania. In his new capacity, Dr. Leslie will be charged with the supervision of the design and fabrication of operating units for the chemical and oil refining industries.

Dr. Leslie is best known to the industrial world for his work as consulting engineer and for his operation, since 1923, of the Leslie Laboratories at Ann Arbor, Michigan.

You'll enjoy the TEXAS STATE when you get to HOUSTON

The Texas State offers the utmost in comfort and modern luxury. Yet rates are well within modest budgets. For instance, complete luncheon is served in our attractive Mezzanine Dining Room for as little as 65c.

HOUSTON'S NEWEST HOTEL

Tub and Shower in all rooms

LOW AS 2.50 A DAY

B. F. ORR, General Manager

RENEW

YOUR

SUBSCRIPTION

PROMPTLY

Colonel W. F. Rockwell Returns from European Trip

In an interview upon his return from a European tour, Colonel W. F. Rockwell, president of Pittsburgh Equitable Meter Company and Merco Nordstrom Valve Company, stated, "After spending two months visiting factories and conferring with officials of seven different companies that manufacture liquid meters, gas pressure regulators, and Nordstrom valves under our patents, in England, Belgium, France, Germany, and Italy, I had a splendid opportunity to study the latest European methods of production and new product development. At the same time, as a result of the trip, arrangements were made to take over several European patents.

COL. W. F. ROCKWELL

"The trip was a 'follow up' to that of one of our representatives, who earlier in the year accompanied the Industrial Research Council on its tour of Europe and made a very thorough study of new developments."

While Colonel Rockwell's trip primarily was to study new European industrial developments, he took the opportunity, while in Europe, to inspect the military trucks being manufactured for the Belgium government. Included in the construction of these trucks are many of his patents, which were developed for the Allied forces during the World War. Colonel Rockwell is still keenly interested in military affairs, being an advisory officer of the War Department's new program of motorization and mechanization of its ground forces.

Lincoln Electric Opens Office in Atlanta, Georgia

The Lincoln Electric Company, manufacturers of arc-welding equipment, Cleveland, Ohio, announces the opening of a welding sales-engineering office at Atlanta, Georgia. The office is at 412 Title Building and is to be under the management of Robert Daniels. Daniels is a competent welding engineer, having had several years' experience in designing for welding and in application of the process to engineering work.

HUNT NOW OFFERS these 7 SERVICES:

Wire Line Coring

Complete Bit Line

Rig Unitization

Boiler Repairing

Machine Work

Oil Field Welding

Field Repair Work

HUNT TOOL COMPANY
HOUSTON, TEX.
Formerly AUTHORIZED APPLEMAN BIT SERVICE CO.
HUNT WIRE LINE CORE BARRELS

SERVICE SHOPS:
Houston, Joinerville, Talco, Corpus Christi, Bay City, Alvin, Texas . . . . . Rodessa, Jennings, Houma, Louisiana.

STRAIGHT TALK.... about CROOKED HOLES

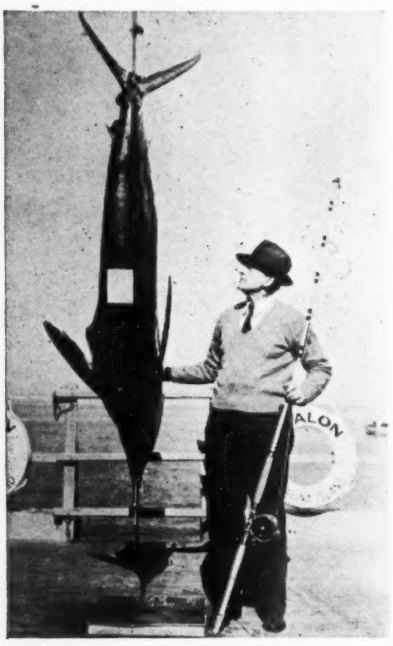
Write for literature

SPERRY-SUN WELL SURVEYING CO.

1608 Walnut Street, Philadelphia, Pa.
425 Petroleum Building, Tulsa, Okla.
3118 Blodgett Avenue, Houston, Texas
549 East Bixby Road (3800 Block—Atlantic Ave.) Long Beach, Calif.
Bank of Lafayette Bldg., Lafayette, La.
c/o Elks Club, 17th and I Streets, Bakersfield, Calif.

O. E. Dustman's Big Catch

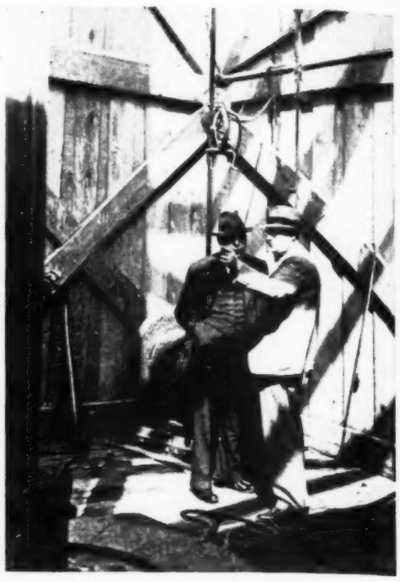
During his spare time, when he's not selling Brodie meters, O. E. Dustman gives the big fish off Santa Cata-



lina island a lot to worry about. The 145-lb., 10-in. sword-fish shown in the accompanying photograph evidently "zigged" when he should have "zagged" and ended up in Dustman's creel; or was it truck? Headman R. N. Brodie, who was along when this fine speciman was taken, is no amateur around Santa Catalina waters himself. Just a few weeks ago he hooked and played the granddad of Dustman's fish—in fact, it was too big for his tackle so it's still enjoying Southern California weather. After looking at the spear-like proboscis on this monster we're going to buy a suit of armor for our next swim off Catalina. You can see from the picture that Dustman is a bit proud of his catch and why shouldn't he be?—it's something that doesn't happen every day.

"Frosty" Martin in Roumania

In the course of a world's tour in the interests of the Martin-Decker Corporation and its customers, W. R. "Frosty" Martin, president, recently was snapped getting the fine points on Roumanian drilling technique from R. Koste. Note the familiar Martin-Decker diaphragm unit on the deadline, and the method of anchoring the deadline to a large drum in a corner of the derrick.



W. R. Martin (left) and R. Koste (right) on derrick floor of Roumanian well

"Frosty" left last July on his trip around the world, and will visit all the major production centers, learning first hand the production and drilling problems in each territory.

Norton McKean Made Vice-President American Meter

Norton McKean was elected vice-president of American Meter Company at a recent board meeting of the direc-

NORTON McKEAN

tors. McKean first became associated with American Meter Company in 1919 as superintendent of its Boston plant, after which he was made general superintendent of the corporation and manager of its Albany, New York, plant — D. McDonald and Company Works. He will continue to perform those executive duties.

A SURE WAY
to keep your well
Producing Efficiently

Up-Trip shown at left

Pack-off Shoe shown at right

The Cavins Perforation Washer is unequalled for cleaning perforated oil strings, liners and screens; permitting a well to produce regularly and efficiently. It is convenient, efficient, and easy to use, and can be assembled in twenty minutes. It consists of The Cavins Bailer with The Cavins Up-Trip and Pack-Off Shoe (illustrated); and requires no special rigging up—a great time saver. It's the best insurance available against losses of time, labor and production, and will pay for itself many times each year. Write for illustrated, descriptive bulletin.

The CAVINS CO.
2853-73 Cherry Ave., Long Beach, Calif.
Cable Address: "Cavins, Long Beach"
Foreign Representative: R. J. Eiche

Branches: CALIFORNIA: Bakersfield, Taft, Ventura. TEXAS: Houston, Kilgore, Odessa, Big Spring, Monahans, Pampa, Graham, Wichita Falls. NEW MEXICO: Eunice. OKLAHOMA: Ada, Oklahoma City, Perry. TRINIDAD, B. W. I.

The CAVINS PERFORATION WASHER

Addition to International Harvester Tractor Works Announced

Completion by next May 1 of a large addition to the International Harvester Company's tractor works at 2600 W. 31st Boulevard, Chicago, Illinois, has been announced by officials of the company. The new addition, with buildings and equipment, will cost in excess of $1,000,000. The construction job, now under way, when completed will make the company's Chicago tractor works one of the world's largest tractor manufacturing establishments.

The new addition will be devoted entirely to the production of International Harvester's line of crawler-type tractors as distinguished from wheel-type tractors. This line of tractors, known as TracTracTors, is used in both agriculture and industry. Five different-size models will be produced in the enlarged plant, including two models powered by Diesel motors. The Diesel engines will continue to be made in the company's manufacturing works at Milwaukee.

A one-story building of saw-tooth design, with brick and steel walls and gypsum roof, the new structure will add 240,000 sq. ft. (six and one-half acres) of floor space, bringing the total floor space of the plant to approximately 1,400,000 sq. feet.

TracTracTor machining and assembling operations will be conducted in the new space, with the assembly line lengthened to 500 ft. and its present output of 40 crawler tractors daily increased to 75.

G-E Plastics Department Opens New Plant

The Plastics Department of the General Electric Company has recently opened a new molding plant at 1 Plastics Avenue, Pittsfield, Massachusetts, which is entirely devoted to the research, development, design, and manufacture of molded plastics products. Representing an investment of approximately one million dollars, the new plant is the scene of the major part of its plastics activities.

The manufacture of plastics parts by General Electric started over 40 years ago with the production of a few component parts for use on G-E products. In the development of the plastics art and the tremendous increase in the use of plastics parts has come a growth of similar proportions in General Electric activities in this field, until the business has trebled within the last five years.

Many Inquiries Concerning Picture of Dredging Equipment

Since publishing its November issue, in which appeared an article describing the laying of the Keystone Pipe Line Company's and the Buffalo Pipe Line Company's gasoline line in the East, *The Petroleum Engineer* has received numerous inquiries concerning the illustration on page 62 showing the dredging of a trench across a river. Readers have asked if this photo portrays the actual conditions under which the equipment was operated, or whether it merely showed an unusual condition resulting from high waters. The condition shown was in no way unusual, the stream being at its normal depth. Operators of the dredging equipment found it necessary to wear gum boots to avoid wet feet.

EACH YEAR we try to find a new way to express our Holiday Greetings to our friends, but after all, there's nothing that quite represents our genuine sentiments like the good, old-fashioned—

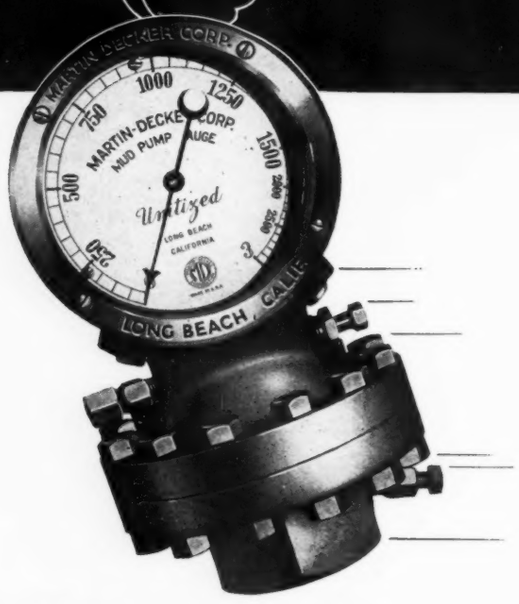
A Merry Christmas and
A Happy New Year

And there's nothing that quite expresses our services to the Oil Industry like—

This Is The Oil Bank of America

NATIONAL BANK OF TULSA

WHERE *Speed* IS ESSENTIAL



FOR QUICK INSTALLATIONS

where a chart record is not required, investigate this new Martin-Decker Unitized Mud Pump Gauge. It is the most rugged unit ever built for measuring slush pump pressures—strong, compact, and gives smooth accurate pressure readings under all conditions. It is as readily installed as a bull plug, and just as easily moved from rig to rig. It is unaffected by rapidly surging pressures or by circulating fluids, and is engineered to withstand the extreme vibration of the slush pump. This is the ideal instrument for shallow drilling, fishing, redrill jobs, and any other work that requires short rig-up time and maximum portability!

The Unitized Mud Pump Gauge contains in one compact unit Diaphragm, Pulsation Damper and Indicator Gauge. The Diaphragm Unit handles 5,000 pounds working pressure, and completely seals circulating fluid out of the gauge mechanism. Gauge and Damper system is filled with non-corrosive, non-freezing fluid that gives accurate pressure readings under all conditions.

The built-in Pulsation Damper gives smooth readings unaffected by pressure surges, yet allows instant sensitivity to actual changes in pressure.

The Indicator Gauge is the new Martin-Decker Vernier Retard type, combining extreme sensitivity with high capacity — a unique arrangement which gives fidelity to the small pressure changes of ordinary oil field work, yet provides ample safety for high pressure operations.

Write for complete literature on this compact new instrument!

Available in two models—3,000-lb. capacity retarded at 1,500 pounds, and 5,000-lb. capacity retarded at 3,000 pounds.

THE WEIGHT INDICATOR
MARTIN-DECKER CORPORATION
LONG BEACH CALIFORNIA
San Joaquin Valley: A. F. McQUISTON, Bakersfield, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

TRADE LITERATURE

DESIGNERS OF HIGH TEMPERATURE INSTALLATIONS who use seamless tubing will be interested in the new booklet, "Digest of Steels for High Temperature Service" just published by the Timken Steel and Tube Division of The Timken Roller Bearing Company, Canton, Ohio.

●

VANADIUM IN CAST IRON, a new 28-page booklet just issued by the Vanadium Corporation of America, describes the improved physical properties of cast irons employing varying amounts of vanadium. Numerous charts and tables list the specifications of various vanadium-containing irons, and a number of commercial applications of vanadium irons are illustrated. For copies of this booklet, write the Vanadium Corporation of America, 420 Lexington Avenue, New York, New York.

●

VERTICAL HOLLOW AND SOLID SHAFT POLYPHASE, ball-bearing, squirrel-cage, induction motors of Fairbanks, Morse and Company, Chicago, Illinois, are described in Bulletin 1410. Although these motors were developed primarily for direct-connection to vertical-shaft turbine, propeller and centrifugal-type pumps, they have found wide application on special machine tools and various other industrial equipment.

●

ANNOUNCEMENT IS MADE BY NATURAL GAS EQUIPMENT, INC., Los Angeles, San Francisco, and Houston, of a new descriptive bulletin on the Boilertrol, a new combination reducing regulator and gas fuel regulator for automatically firing gas-fired oil-field boilers. Copies of Bulletin No. 515 are obtainable by writing the manufacturers at the Petroleum Securities Building, Los Angeles, California.

●

THE "LUBRICANT MANUAL FOR NORDSTROM VALVES," has been issued by the Merco Nordstrom Valve Company, Pittsburgh, Pennsylvania, for the purpose of making recommendations for the use of "Nordco" lubricants in connection with Nordstrom valves. The manual goes into greater detail than is possible in the Lubricant Chart published in the Merco-Nordstrom catalog.

T. M. ROBIE

New Manager F-M Diesel Sales

The appointment of T. M. Robie as manager of the Diesel sales division of Fairbanks, Morse and Company, Chicago, has been announced by A. C. Dodge, vice-president in charge of sales.

Robie has been associated with Fairbanks-Morse since he returned from World War overseas service in 1919, serving in numerous capacities in the manufacturing and sales division. Since 1932 he has been in charge of Diesel sales to resale manufacturers.

William Bovaird Passes Away

William J. Bovaird, founder and the chairman of the board of directors of the Bovaird Supply Company, Tulsa, Oklahoma, and one of the veteran supply men of the petroleum industry, died November 25 at his home in Independ-

ence, Kan. He was 74 years old, and had been confined to his bed for two weeks by a heart ailment.

Born in Shamburg, Pennsylvania, March 25, 1863, he grew up at Bradford and worked with his father in the supply business. He kept informed of the migratory habits of the industry and in 1903 he became convinced that the Mid-Continent was an area of great promise and went to Independence, then the capital of the Kansas-Indian Territory district.

He established the Bovaird Supply Company and was its active manager until about 1925, when he surrendered the presidency and became chairman of the board.

K. R. Kingsbury Dies of Heart Attack

Kenneth R. Kingsbury, president of Standard Oil Company of California, died suddenly of a heart attack November 22 aboard the liner Santa Paula on which he was taking a vacation cruise to Havana. The body was returned to San Francisco for burial.

K. R. KINGSBURY

The oil company executive dropped dead while dressing for dinner as the liner was passing through Panama Canal. A coroner's inquest at Colon decided he died of a heart attack.

Kingsbury began his career with the Standard Oil Company in Pennsylvania as a pipe-checker and fireman December 27, 1897. In 1919 he became the youngest president in the group of the Standard Oil corporations.

He was born in Columbus, Ohio, in 1876, was graduated from Princeton in 1896, and took a year's post graduate work in mining engineering at Columbia University.

After two years in the field for the oil company, Kingsbury entered the New York office, became a salesman, and in 1906 was named agent of Standard Oil Company of California at New York and later assistant to the president of that corporation. He advanced through vice-presidencies to the office of president in 1919.

Kingsbury was vice-president-at-large of the American Petroleum Institute.

At a meeting of the board of directors on December 9 William H. Berg, senior vice-president of the Standard Oil Company of California, was elected president to succeed Kingsbury.

To Drill Exploratory Test in West Indies

John S. Freeman, assistant to Hugh M. Stalcup, vice-president in charge of production of the Skelly Oil Company, left Tulsa, Oklahoma, recently for the Dominican Republic in the West Indies to assist in getting under way the first test for oil to be drilled on the 500,000-acre concession procured by Clem S. Clark, independent operator of Shreveport, Louisiana, in which Skelly took an interest.

M. W. Mathews, assistant superintendent in the Oklahoma City area for the Skelly Oil Company, also has sailed with a drilling crew. On the same boat is rotary drilling equipment capable of drilling to a depth of 3000 feet. The initial drilling operations are to determine possibilities of the concession for further oil development.

Dodge Clutches Can Handle the Toughest Jobs . . .

Dodge Diamond "D" Friction Clutches are efficiently, dependably, and economically adapted to power transmission as well as for application to various types of machinery used in the oil fields. They are ruggedly constructed and capable of handling 100% overload, insuring safety and protection and positive power control under any conditions of service.

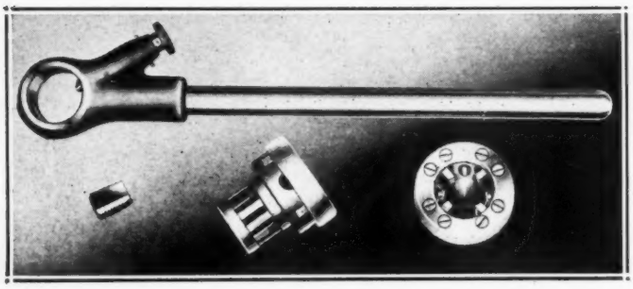
See the Dodge 20-page section in the Oil Field Composite Catalog

Specify Dodge Diamond "D" Clutches for steady, uninterrupted service. Send for copy of Catalog No. A-200.

DODGE MANUFACTURING CORPORATION
MISHAWAKA, INDIANA, U. S. A.

THE Right DRIVE FOR EVERY JOB

DODGE
MISHAWAKA
THERE IS ADDED VALUE IN THE NAME DODGE



THE NEW No. 2 BEAVER "Open" Ratchet

Threads ⅛" to ¾" Pipe; ¼" to 1" Bolts. Sold in Units—Competitive in Price!

The New No. 2 is a lower-priced version of the long-popular No. 3 Beaver—lacking only the safety feature of the enclosed ratchet.

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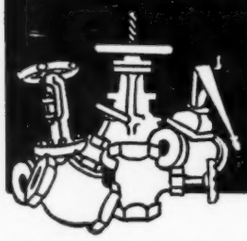

Don't junk valves ... or other fittings on equipment just because they're covered with heavy muck and grease. They're still worth money to you!

Salvage them the low-cost, easy Oakite way that so many other concerns are doing today. No scrubbing or scraping ... a short soak in a solution made up with recommended Oakite materials, a rinse and parts are clean, ready for inspection and necessary repairs. Send today for free booklet describing safe, economical methods for doing all types of producing or refining cleaning tasks. No obligation.

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Book Reviews

Man in a Chemical World. By A. Cressy Morrison. Published by Charles Scribner's Sons, New York City, 1937. 292 pp. Price, $3.00.

"Man in a Chemical World" is an autobiography of an industry. It is an account of the activities of the chemical industry in converting the discoveries of science into day-by-day necessities. Its matter-of-fact presentation of the workings of science, as applied to the problems of living, reveals the fascinating romance of modern industrial life. The author summarizes the vital part played in American life by this translator of scientific abstractions (the chemical industry) into the materials essential to civilization and progress. Coöperation of hundreds of leading industrialists in reviewing the material presented assures accuracy and lends additional authority to the volume.

* * *

Comprehensive Index of the Publications of the American Association of Petroleum Geologists. By Daisy Winifred Heath. Published by The American Association of Petroleum Geologists, Box 979, Tulsa, Oklahoma. London: Thomas Murby and Company, 1, Fleet Lane, E.C.4. 382 pp. Price, members and associates, $2.00; non-members, companies, and institutions, $3.00, postpaid.

As its name indicates this volume is an index of all publications of the American Association of Petroleum Geologists, covering the past 20 years. Geologists, particularly those in the field of petroleum and natural gas and the closely allied subjects of structure, stratigraphy, and tectonics, will find it a very useful work.

* * *

Liquid Fuels. By Harold Moore. Published by D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York City; and The Technical Press, Ltd., London, England.

The author has prepared a volume designed as a practical treatise for engineers and chemists on the manufacture, properties, utilization, and analysis of liquid fuels. No attempt has been made, however, to make the treatise an exhaustive one, the volume being intended solely as a concise manual for those engaged in the petroleum industry, for engineers manufacturing or operating internal combustion engines, and for those of the public who may wish to make a survey of the subject.

* * *

U. O. P. Laboratory Test Methods for Petroleum and Its Products. Compiled and edited by Charles Wirth, III, and Frank J. Vitovec, Jr. Published by Universal Oil Products Company, Chicago, Illinois. Price, $3.00.

Testing methods for various fractions of petroleum, ranging from gaseous hydrocarbons to coke, are contained in this volume. These test methods, numbering about 100, have been compiled and edited by Charles Wirth, III, and Frank J. Vitovec, Jr., with the assistance of their associates in the analytical and control laboratories and the counsel of members of the Universal Oil Products Company's research and development laboratories at Riverside. Many of them have been used for a number of years and all have been tested and proved in the Universal laboratories.

The book contains 250 pages, is substantially bound in board covers, which permits it to lie flat when opened. It is illustrated by a number of drawings of the apparatus described and graphs for the interpretation of the tests.

The Flow of Homogeneous Fluids Through Porous Media, by M. Muskat. Published by McGraw-Hill Book Company. 763 pp. Price $8.00.

The fundamental principles of the general subject of fluid flow are modified to apply to the special case of fluids flowing through porous media. Typical practical problems likely to be encountered in oil, gas, or water development, dam construction, irrigation, and related activities are analyzed and the methods of solution explained in detail. Depth of penetration of oil- or gas-producing formations, acid treatment of oil-producing formations, water-coning, well-spacing, water-flooding programs, and gas-oil ratios are but a few of the individual problems treated. Complete derivation of all formulae is presented, but a non-technical summary of each of the technical chapters is provided for the benefit of the reader having only a limited knowledge of mathematics. Numerous simple cross-references permit quick and easy reference to explanatory or supplementary discussion of any phase of the subject.

This volume should be particularly valuable to the technically trained petroleum engineer, as it is by far the most comprehensive work dealing with the more complicated problems of fluid flow through porous media that has yet appeared.

* * *

Practical Petroleum Engineers' Handbook, by Joseph Zaba and W. T. Doherty. Published by Gulf Publishing Company, Houston, Texas. 401 pp. Price $5.00.

The volume consists essentially of formulae, tables, charts, and graphs compiled from several sources and designed for easy solution of actual operating problems, discussion being limited to explanation of procedure in using the charts and to explanatory comment. The solution of the more complicated problems is illustrated by specific examples. Separate chapters are devoted to general engineering data, steam, power transmission, tubular goods, drilling, production, and transportation. There are many valuable charts, the small size of some of which is a defect that unfortunately impairs their usefulness. Engineers and field men with engineering training who are called upon to solve a variety of problems or who frequently encounter problems slightly different from the type with which they are already familiar should find the book useful for quick reference.

* * *

Polymerization, by R. E. Burk, H. E. Thompson, A. J. Weith, and Ira Williams. American Chemical Society Monograph 75. Published by Reinhold Publishing Corporation, New York. 312 pp., 1937. Price $7.50.

The results of all experiments pertaining to polymerization, and the relationships observed or postulated have been classified and evaluated by the authors as a necessary preliminary step in analyzing current theories regarding polymerization. Commercial importance and application of polymerization in the rubber, synthetic resin, and petroleum industries are discussed in detail and possible future trends are indicated. The chapter entitled Polymerization in the Petroleum Industry includes information concerning both the formation and the deterioration of products as a result of polymerization, and the complimentary effects of catalysts and inhibitors.

This volume should be of unlimited value to the refinery laboratory technician, and even a cursory reading should suggest to executives attractive lines for future research and development.

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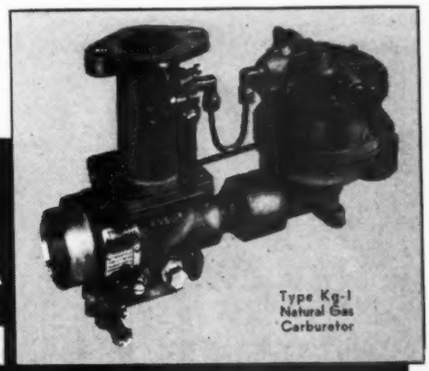

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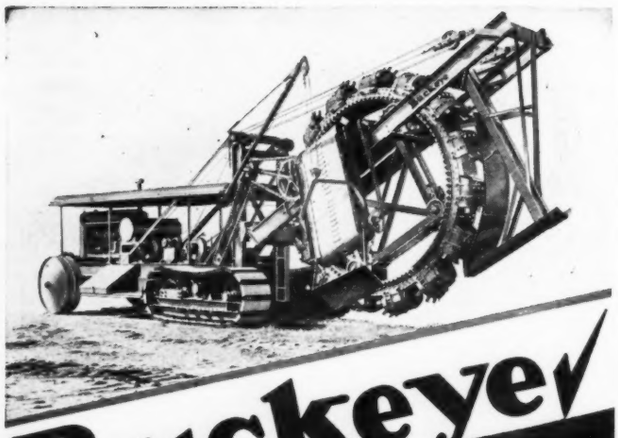

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Cooper-Bessemer Opens New Warehouse

The Cooper-Bessemer Corporation recently completed a new warehouse building at Pampa, Texas. Because of the increasing number of Cooper-Bessemer oil-field engines, both gas and Diesel, which are being installed in this territory, the company wishes to provide a source of field service and spare parts closer to the installations.

McCarnes Promoted by Union Wire Rope

The appointment of A. P. McCarnes to take charge of oil country sales in the state of Texas, has been announced by H. R. Gruber, vice-president in charge of sales for the Union Wire Rope Corporation, Kansas City, Missouri. McCarnes has represented the company in West Texas, with headquarters at Pampa, but as division sales manager for the state will make his headquarters at Dallas.

Sons of Oilmen Star on Gridiron

In the accompanying photograph are shown Glenn Emrick (left) and Jack Daly, jr., (right), who have made quite a

name for themselves on the gridiron, playing for Texas Military Institute at San Antonio, Texas. Both were placed on the Southwest Academic All-Conference team this year. The gentleman standing between them is W. A. Bondurant, president of Texas Military Institute.

Interesting to note, both young men have at one time been resident with their parents in the oilfields of Upper Burma, India.

Glenn is the son of Bert Emrick of Houston, Texas, well-known throughout the petroleum industry and who has just organized the firm of Bert R. Emrick, Inc. Jack, jr., is the son of E. J. Daly of Houston, salesman for the Wickwire Spencer Sales Corporation.

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This is the fastest operating perforator ever developed. It relieves the casing of all strain by cutting perforations, three at a time, equally spaced, peripherally and prevents weakening of the pipe or egg-shaping the casing. Perforations of various sizes can be made by selecting different size points on the wheel knives with which the tools come equipped. This tool is also readily adapted to all one-string perforation jobs.

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Dowell Incorporated Announces Changes in Personnel

Dowell Incorporated announces several important appointments and changes in personnel.

W. E. REARDON

W. E. (Bill) Reardon, who was district manager of Dowell Incorporated at Seminole, Oklahoma, has been transferred to the general office at Tulsa as assistant manager.

W. J. Russell, who was district manager at Tulsa, Oklahoma, succeeds Reardon at Seminole, Oklahoma, having charge of treating stations at Tulsa, Seminole, and Stonewall, Oklahoma.

H. W. Ross has been appointed assistant sales manager and is located at Tulsa, Oklahoma.

P. J. Lehnhard has been promoted from treating engineer at Tulsa, Oklahoma, to research engineer on the general office staff at Tulsa.

W. J. RUSSELL

E. S. Villines has been transferred from Hobbs, New Mexico, where he served in the capacity of treating engineer, to Tulsa, Oklahoma, as manager of the Tulsa station.

Ward B. Tennis, formerly station manager for Dowell at Great Bend, Kansas, has been promoted to district sales engineer at Wichita, Kansas.

Jack Sutherlin succeeds Tennis as station manager at Great Bend.

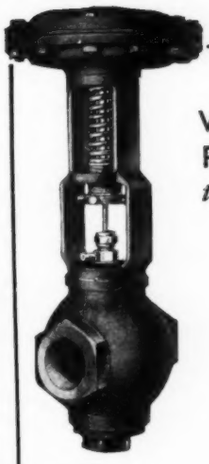
H. W. ROSS

Dowell Incorporated also has announced the establishment of a (Panhandle district) district office in the Rule Building, Amarillo, Texas, with R. L. White as district manager. The treating station is at Borger, Texas, with O. W. Lyons as station manager and R. L. Shrewsbury as treating engineer.

A new district office also has been established at Stamford, Texas, with Fred R. Holland, formerly station manager at Ada, Oklahoma, as district manager. C. F. Wilkes is treating engineer, having been transferred from Cody, Wyoming. The district office at Wichita Falls has been discontinued; however, treating facilities will be maintained in Wichita Falls.

Bert Emrick Organizes Firm

Bert R. Emrick, following completion of a special pressure-drilling job for Stanolind Oil and Gas Company, has organized the firm of Bert R. Emrick, Inc., to service or deepen producing wells. The largest size portable unit obtainable for this type of work is being moved into the Corpus Christi, Texas, territory to begin work immediately after Christmas. This service will be available to the entire Gulf Coast, and will handle wells of 8000-ft. and 9000-ft. depths. Headquarters of the new corporation are 1018 Travis Street, Houston, Texas.



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The V-Port gradual-opening valve here shown is thoroughly dependable with flow controllers and instrument-type auxiliary-controlled pressure regulators and with many other forms of refinery equipment. Has many applications also in other industries. Made for either direct action (closed by diaphragm pressure) or indirect action (opened by diaphragm pressure). Sizes ½-inch up, all with ample diaphragm area to give positive unfailing response.

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This pump is run in on the sucker rods, and seats in an installed working barrel. Without damage to cups, it can easily be unseated to make rod repairs. Through improved design, the Huf-Duo also reduces power consumption and rod stress.

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Reduce
FIRE HAZARD
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ACCUMULATIONS of grease, muck and oil drippings around derricks, pumping equipment and floors . . . or in fact an accumulation of oil and grease ANYWHERE . . . is a fire hazard that should be eliminated.

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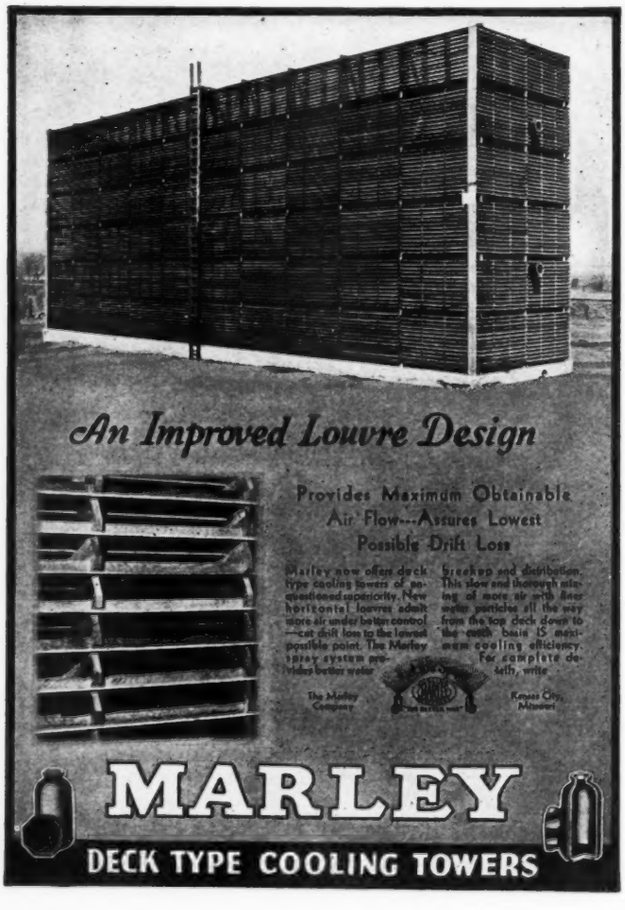
An Improved Louvre Design
Provides Maximum Obtainable Air Flow---Assures Lowest Possible Drift Loss
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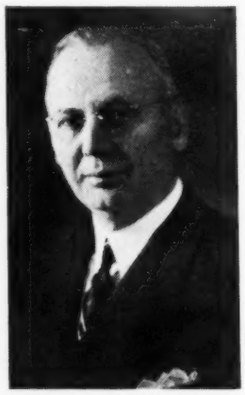
DECK TYPE COOLING TOWERS

H. P. Taubman Resigns from Bethlehem Supply; Succeeded by G. A. Tompson



G. A. TOMPSON

H. P. TAUBMAN

Herman P. Taubman, Tulsa, Oklahoma, has resigned as executive vice-president and general manager of the Bethlehem Supply Corporation, subsidiary of the Bethlehem Steel Corporation, and has been succeeded by Guy A. Tompson. The latter has been associated with the company as vice-president in charge of sales.

Taubman founded the Taubman Supply Corporation 17 years ago, which was acquired by the Bethlehem Steel Corporation in 1936. He plans first to take a rest, after which he may become active in the production branch of the petroleum industry.

Firm Changes Mailing Address

P. & D. Specialty Manufacturing Company, Houston, Texas, announces a change in its mailing address from 1836 Airline Drive to P. O. Box 3091, Houston. The telephone number is Taylor 8191.

R. F. Davis is president of the firm, A. J. Penick is vice-president, and K. T. Penick is secretary-treasurer.

McGregor and Thilenius Given Hose Account

McGregor and Thilenius, Tulsa, Oklahoma, have been appointed representatives for the Atlantic Metal Hose Company, New York City, for the states of Kansas and Oklahoma. The line of hose includes all types of flexible metal hose, in steel and copper, and also seamless steel hose for use on Diesel engine exhaust lines in place of expansion joints.

A. O. Smith Corporation Purchases Smith Meter Company

Announcement has been made by W. C. Heath, president of the A. O. Smith Corporation, Milwaukee, Wisconsin, that they have purchased the Smith Meter Company, of Los Angeles, California, manufacturers of rotary truck, loading rack, and refinery meters. Reorganization of manufacturing and sales departments is now in progress to increase production to enable them to take care of demands from the petroleum industry, it is stated.

Mid-Continent District A.P.I. to Meet February 17-18

The annual spring meeting of the Mid-Continent District, Division of Production of the American Petroleum Institute, will be held at the Herring Hotel, Amarillo, Texas, on February 17 and 18, 1938, it has been announced.

The following committee members have been appointed:

Registration Committee—R. C. Kay, chairman, independent operator, Amarillo, Texas; E. N. Armstrong, Shamrock Oil and Gas Company, Amarillo; Walter E. Biery, Sinclair-Prairie Oil and Gas Company, Pampa, Texas; Ed. Dunigan, Dunigan Tool and Supply Company, Pampa; Ed Goebel, Jake Phillips Oil Company, Amarillo; D. J. Gribbon, The Texas Company, Pampa; Fred Radcliff, Radcliff Supply Company, Pampa; Mandy Rieger, Rieger Oil Company, Amarillo; and G. J. Turner, Phillips Petroleum Company, Whittenburg, Texas.

Publicity Committee—N. D. Bartlett, chairman, *News-Globe*, Amarillo; Claude V. Barrow, *Daily Oklahoman*, Oklahoma City, Oklahoma; L. G. E. Bignell, *Oil and Gas Journal*, Tulsa, Oklahoma; Jack Casburn, *Oil Weekly*, Tulsa; Paul Hedrick, *Tulsa World*, Tulsa; Harry Hoare, *Pampa Daily News*, Pampa; L. M. Ladet, *Tulsa Tribune*, Tulsa; K. J. Langley, *Oil and Gas Journal*, Tulsa; Grant McGee, *The News*, Oklahoma City; Brad Mills, *Oil Weekly*, Houston; J. C. Phillips, *Borger Daily Herald*, Borger, Texas; R. H. Richards, *Wichita Beacon*, Wichita, Kansas; K. F. Sauer, *The Eagle*, Wichita; K. C. Sclater, *The Petroleum Engineer*, Dallas, Texas; L. E. Smith, *National Petroleum News*, Tulsa; and H. M. Cosgrove, Purchasing Agents' Association of Tulsa.

Entertainment Committee—Mason King, chairman, *News-Globe*, Amarillo; Bill Flenniken, Halliburton Oil Well Cementing Company, Amarillo; Frank Harris, Lee C. Moore and Company, Amarillo; Wm. McSkimins, Oil Well Supply Company, Pampa; Vern Hobbs, General Supply Company, Pampa; George Berlin, Skelly Oil Company, Pampa; Polly Parrott, Trinity Portland Cement Company, Amarillo; Alex Schneider, Schneider Hotel, Pampa; W. H. McCue, Columbian Fuel Corporation, Amarillo; and C. O. Drew, Acme Lumber Company, Pampa.

Program Committee—C. A. Daniels, Phillips Petroleum Company, Amarillo; K. I. Dunn, Texas Railroad Commission, Pampa; J. S. Freeman, Skelly Oil Company, Tulsa; H. O. Harder, I. T. I. O. Company, Oklahoma City; A. J. Holland, The Texas Company, Pampa; W. F. Dean, Humble Oil and Refining Company, Pampa; Max M. Mahaffey, Cities Service Gas Company, Eldorado, Kansas; Harry Mathews, Stanolind Oil and Gas Company, Pampa; A. S. Ritchie, McPherson Drilling Company, Wichita; Donald A. Powell, Drilling and Exploration Company, Pampa; K. R. Teis, E. H. Moore, Inc., Tulsa; W. H. Collins, Shell Petroleum Corporation, Amarillo; and Austin Allen, Phillips Petroleum Company, Amarillo.

Wildcats Elect Officers

The following men have been elected officers of the Wildcat Committee of the California Oil and Gas Association for the year 1938: Frank Morgan, chairman (vice-president, Richfield Oil Company of California); J. R. Pemberton, vice-chairman (oil umpire of California); Neil C. Needham, treasurer (manager, land department, General Petroleum Corporation of California); D. S. Kilgour, secretary (assistant manager, California Oil and Gas Association).

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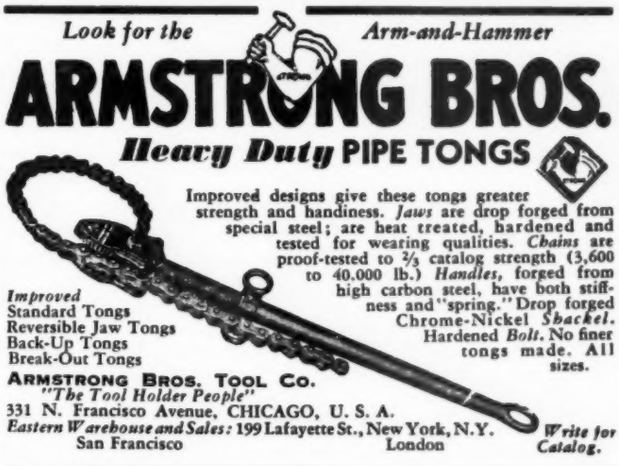
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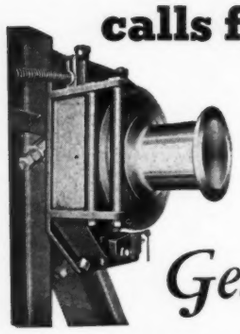

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The high speeds at which many line shafts are being run in today's drilling operations makes it practically imperative that a cathead be geared down to reduce the terrific impact when breaking tool joints. Conventional catheads, when slowed down, lose most of their power, but not the MacClatchie Gearomatic. Due to its patented gear arrangements, it rotates at HALF the line shaft speed yet gives DOUBLE the power.

It breaks the tightest joints with ease and without damage to tongs, tong dies, or other equipment.

A positive kick-out and slow motion insures greater safety. The positive kick-out permits one revolution, and only one, per pull. Consequently, there is no danger of fouled lines injuring workmen or damaging rig equipment when you use the MacClatchie Gearomatic Cathead.

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A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 7

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*This index is revised monthly as additional tables are published.

(a) In footnote, "feet" shout read "inches."

(b) Headings "Redwood No. 1 seconds" and "Redwood admirality seconds" should be transposed.

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PRESSURE DROP, LB. PER SQ. IN. PER MILE OF 10-in.[1] PIPE LINE (Oil of 40° A.P.I.)

Quantity of 40° A.P.I. oil, bbl. per hr.	Viscosity of oil, Saybolt Universal seconds										
	50	60	70	80	90	100	110	120	130	140	150
650	3.43	3.74	3.98	4.17	4.36	4.50	4.63	4.75	4.86	4.97	5.07
675	3.66	3.99	4.25	4.46	4.65	4.81	4.95	5.08	5.20	5.31	5.42
700	3.90	4.25	4.52	4.75	4.95	5.12	5.27	5.41	5.54	5.65	5.77
725	4.14	4.52	4.80	5.05	5.26	5.45	5.60	5.75	5.89	6.01	6.13
750	4.39	4.80	5.10	5.35	5.58	5.78	5.94	6.10	6.24	6.38	6.50
775	4.64	5.08	5.39	5.66	5.90	6.11	6.29	6.45	6.60	6.75	6.87
800	4.90	5.37	5.69	5.98	6.23	6.45	6.65	6.82	6.98	7.13	7.27
825	5.16	5.66	6.00	6.31	6.57	6.80	7.02	7.19	7.36	7.52	7.67
850	5.43	5.96	6.32	6.65	6.91	7.16	7.39	7.59	7.76	7.93	8.08
875	5.71	6.26	6.65	6.98	7.27	7.53	7.77	7.98	8.16	8.34	8.50
900	5.99	6.57	6.98	7.32	7.63	7.90	8.14	8.37	8.57	8.75	8.92
925	6.28	6.89	7.33	7.67	8.00	8.28	8.53	8.78	8.99	9.17	9.36
950	6.58	7.21	7.68	8.04	8.38	8.67	8.94	9.19	9.42	9.61	9.80
975	6.88	7.53	8.04	8.41	8.77	9.07	9.34	9.61	9.85	10.06	10.25
1000	7.18	7.87	8.40	8.79	9.15	9.47	9.77	10.04	10.29	10.52	10.71
1025	7.51	8.21	8.77	9.19	9.55	9.89	10.20	10.47	10.75	10.98	11.19
1050	7.82	8.55	9.14	9.58	9.95	10.31	10.63	10.90	11.19	11.44	11.66
1075	8.16	8.90	9.52	9.98	10.37	10.74	11.07	11.36	11.65	11.92	12.15
1100	8.49	9.26	9.91	10.39	10.78	11.18	11.51	11.83	12.12	12.41	12.65
1125	8.83	9.62	10.30	10.80	11.21	11.62	11.98	12.29	12.60	12.89	13.15
1150	9.17	10.00	10.69	11.23	11.65	12.06	12.45	12.78	13.08	13.39	13.61
1175	9.52	10.36	11.08	11.65	12.09	12.51	12.90	13.25	13.57	13.88	14.19
1200	9.89	10.75	11.49	12.09	12.54	12.98	13.38	13.74	14.08	14.41	14.72
1225	10.26	11.14	11.91	12.52	13.01	13.45	13.87	14.23	14.59	14.92	15.25
1250	10.65	11.53	12.32	12.97	13.48	13.92	14.36	14.75	15.11	15.44	15.78
1275	11.03	11.93	12.75	13.43	13.96	14.40	14.86	15.28	15.64	15.98	16.32
1300	11.42	12.34	13.18	13.87	14.44	14.90	15.36	15.80	16.17	16.54	16.88
1325	11.80	12.76	13.62	14.33	14.92	15.40	15.86	16.32	16.70	17.09	17.44
1350	12.19	13.17	14.06	14.80	15.41	15.91	16.39	16.84	17.26	17.64	18.01
1375	12.59	13.60	14.51	15.28	15.91	16.43	16.92	17.40	17.83	18.21	18.58
1400	12.99	14.04	14.96	15.76	16.42	16.95	17.46	17.95	18.38	18.79	19.18
1425	13.40	14.48	15.42	16.25	16.92	17.50	18.01	18.50	18.96	19.37	19.79
1450	13.80	14.92	15.87	16.73	17.43	18.04	18.55	19.05	19.54	19.96	20.37
1475	14.22	15.38	16.33	17.22	17.97	18.58	19.11	19.63	20.13	20.56	20.99
1500	14.63	15.83	16.82	17.74	18.51	19.15	19.67	20.21	20.72	21.17	21.60
1525	15.05	16.29	17.31	18.24	19.04	19.70	20.23	20.79	21.33	21.79	22.23
1550	15.48	16.76	17.81	18.74	19.57	20.27	20.83	21.38	21.91	22.41	32.86
1575	15.90	17.23	18.31	19.27	20.10	20.83	21.43	21.97	22.52	23.04	23.50
1600	16.32	17.72	18.81	19.78	20.66	21.41	22.02	22.59	23.12	23.66	24.17
1625	16.79	18.22	19.33	20.32	21.23	21.98	22.64	23.19	23.74	24.32	24.82
1650	17.25	18.73	19.84	20.87	21.78	22.57	23.26	23.83	24.39	24.96	25.48
1675	17.72	19.24	20.36	21.42	22.35	23.18	23.88	24.47	25.02	25.61	26.14
1700	18.19	19.76	20.88	21.94	22.94	23.78	24.51	25.11	25.66	26.26	26.84
1725	18.66	20.28	21.43	22.49	23.49	24.36	25.10	25.76	26.32	26.91	27.50
1750	19.15	20.81	21.96	23.05	24.08	24.97	25.74	26.41	26.99	27.60	28.21
1775	19.63	21.35	22.50	23.62	24.67	25.59	26.39	27.08	27.67	28.30	28.92
1800	20.12	21.88	23.07	24.22	25.27	26.22	27.03	27.75	28.36	28.97	29.61
1825	20.62	22.39	23.65	24.80	25.88	26.85	27.69	28.42	29.05	29.67	30.30
1850	21.12	22.94	24.19	25.38	26.49	27.49	28.35	29.13	29.74	30.39	31.03
1875	21.61	23.48	24.77	25.95	27.09	28.12	29.00	29.81	30.47	31.09	31.72
1900	22.12	24.04	25.36	26.57	27.70	28.76	29.67	30.50	31.17	31.82	32.46
1925	22.63	24.60	25.96	27.16	28.32	29.41	30.34	31.19	31.89	32.54	33.20
1950	23.14	25.17	26.56	27.79	28.98	30.06	31.01	31.89	32.64	33.28	33.95
1975	23.66	25.74	27.17	28.43	29.61	30.75	31.73	32.59	33.37	34.02	34.71
2000	24.18	26.31	27.78	29.03	30.24	31.41	32.42	33.34	34.13	34.80	35.47
2025	24.69	26.88	28.38	29.67	30.91	32.07	33.10	34.04	34.85	35.54	36.27
2050	25.22	27.46	29.00	30.32	31.55	32.73	33.83	34.75	35.63	36.34	37.04
2075	25.75	28.05	29.62	30.93	32.23	33.40	34.53	35.52	36.38	37.14	37.82
2100	26.28	28.64	30.25	31.59	32.88	34.12	35.23	36.25	37.12	37.91	38.60
2125	26.82	29.23	30.88	32.25	33.57	34.85	35.98	36.97	37.92	38.72	39.43
2150	27.35	29.82	31.56	32.91	34.26	35.52	36.68	37.74	38.66	39.53	40.21
2175	27.89	30.42	32.20	33.58	34.97	36.25	37.44	38.48	39.47	40.31	41.05
2200	28.44	31.02	32.89	34.26	35.68	36.94	38.16	39.22	40.23	41.14	41.90
2225	28.99	31.63	33.54	34.94	36.39	37.68	38.93	40.01	41.00	41.93	42.76
2250	29.54	32.24	34.20	35.63	37.11	38.38	39.65	40.82	41.82	42.77	43.62

[1]32.75 lb. per ft. For 35.75 lb. line pipe the pressure drop is about 2.8% greater and for 41.85 lb. line pipe it is about 8.9% greater.

SPECIALISTS 20 YEARS
in Pipe Line Pumps

Fig. 601. GASO Walking Beam Pump—30.30 to 55.10 Bbls. per Hr.

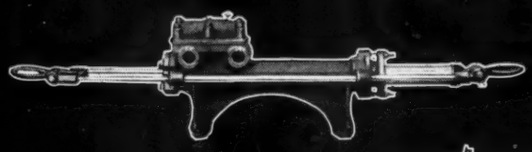


Fig. 201. GASO Rodline Pump — 30.96 to 41.28 Bbls. per Hr.

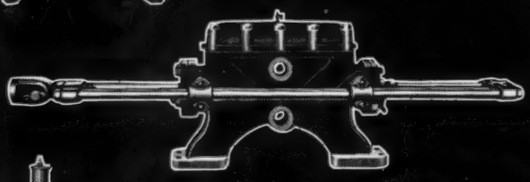


Fig. 301. GASO Piston Power Pump—31.73 to 157.36 Bbls. per Hr.

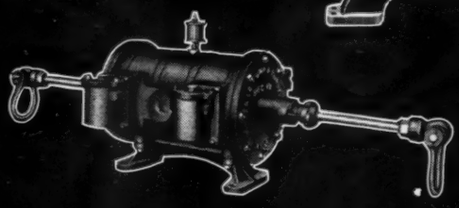


Fig. 604½. GASO Rodline Pump for Gas or Vacuum—26-28 Points Vacuum

Fig. 604. GASO Walking Beam Pump, Gas or Vacuum — 26-28 Pts. Vac.

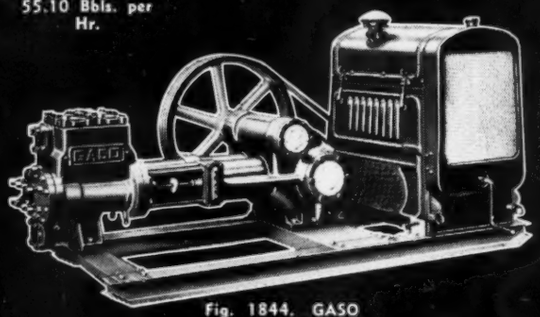


Fig. 1844. GASO Duplex Piston Pump 50 to 288 Bbls. per Hr.

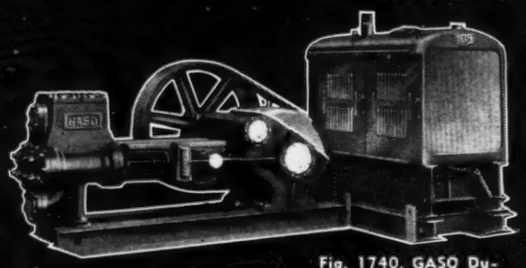


Fig. 1740. GASO Duplex Piston Pump — Gasoline Engine Drive, 54 to 250 Bbls. per Hr.

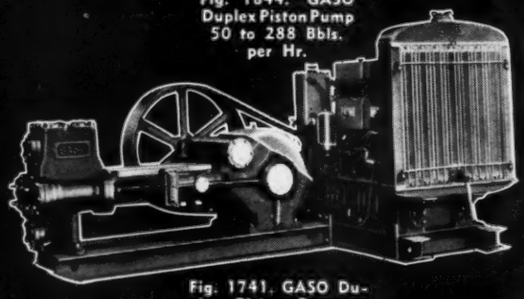


Fig. 1741. GASO Duplex Piston Pump — Diesel Engine Drive—54 to 502 Bbls. per Hr.

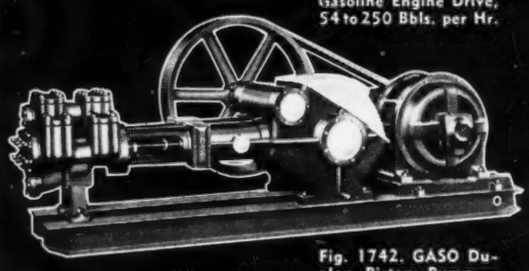


Fig. 1742. GASO Duplex Piston Pump — Electric Drive—54 to 250 Bbls. per Hr.

See GASO Section, 1937 Composite Catalog, or Send for Complete Catalog

GASO PUMP & BURNER MFG. CO., Tulsa, Okla.
Export Office: 149 Broadway, New York

GASO PUMPS

GRAVITY INDEX OF OIL

Viscosity of oil at 100 deg. fahr., Saybolt Universal seconds	Gravity of oil, °A. P. I.									
	18	20	22	24	26	28	30	32	34	36
100				33	56	73	87	98	108	114
125			3	39	61	78	91	102	111	117
150			12	44	65	82	94	104	113	119
175			17	48	68	84	96	106	114	
200			21	51	71	86	98	108	116	
225			25	54	73	88	99	109	117	
250			28	56	75	90	101	111	118	
275			31	58	76	91	102	112	119	
300			33	60	77	92	103	113	120	
350			37	63	80	94	105	114		
400		4	41	65	82	96	107	115		
500		12	46	69	85	98	109	117		
600		19	50	72	88	101	111	119		
700		23	54	74	90	103	113			
800		26	56	76	92	104	114			
900		29	58	78	94	105	115			
1000		32	60	80	95	107	116			
1250		38	64	84	98	109	118			
1500		42	68	87	101	112	120			
1750	5	46	71	89	103	113				
2000	10	49	73	90	104	114				
2250	15	51	75	92	105	116				
2500	18	53	76	94	106	117				
2750	21	55	77	95	108	118				
3000	24	57	79	96	109	118				

From McCluer and Fenske's chart, *Ind. Eng. Chem.* **24**, 1371 (1932).

133 TAYLOR CONTROLLERS ON FOUR COMBINATION CRACKING UNITS

Panel board in one of the Combination Cracking Units, showing some of the Taylor Instruments that help to produce highest quality refined products. Photo courtesy The Lummus Company.

Taylor and Lummus engineers cooperate in providing precision control of temperature, flow and pressure

ONE of the country's largest refiners not so long ago specified a Lummus-designed Combination Selective Cracking Unit. For this unit Taylor engineers, working with Lummus, provided Taylor Systems for controlling temperature, flow, and pressure. They supplied not only the correct instruments, but a thorough experience in refinery operation and a wide knowledge of refining problems.

The precision control and the flexibility of Taylor Controllers helped to produce results that met all guarantees as to yield, octane, and fuel oil specifications for the unit. So successfully did Taylor Systems perform in this unit that they were selected for a second . . . and a third . . . and a fourth. One was in a Gulf Coast refinery, and three other units were in plants in the middle Ohio field.

In all there are 61 Taylor Fulscope Recording Controllers for exact temperature regulation, with Taylor Dubl-Response Control Units on Taylor Motosteel Evenaction Valves. There are 50 Taylor Recording Flow Controllers with Taylor Valv-Precisors on Motosteel Valves. And there are 22 Taylor Fulscope Indicating Pressure Controllers with Taylor Valv-Precisors on Motosteel Evenaction Valves.

For detailed information about these installations and application of Taylor Control to temperature, pressure, flow, and liquid level in your plant, ask a Taylor Representative—or write direct to Taylor Instrument Companies, Rochester, N.Y. Plant also in Toronto, Canada. Manufacturers in Great Britain—Short & Mason, Ltd., London, England.

Taylor

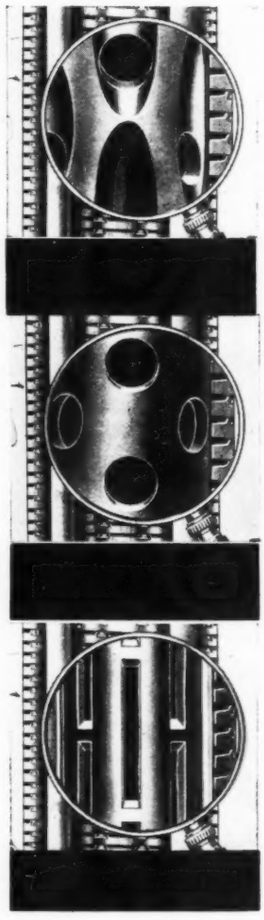
Indicating Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* LEVEL INSTRUMENTS

CAPACITY OF SMALL VERTICAL CYLINDRICAL TANKS

Tank dimensions (internal)				Capacity, bbl.			Tank dimensions (internal)				Capacity, bbl.		
Diameter		Circumference		Per ft.	Per in.	Per 1/8 in.	Diameter		Circumference		Per ft.	Per in.	Per 1/8 in.
1 ft.	0 in.	3 ft.	2 in.	0.140	0.012		7 ft.	0 in.	22 ft.	0 in.	6.85	0.571	.0714
	2		8	0.190	0.016			2		6	7.18	0.599	.0748
	4	4	2	0.249	0.021			4	23	0	7.52	0.627	.0784
	6		9	0.315	0.026			6		7	7.87	0.656	.0820
	8	5	3	0.389	0.032			8	24	1	8.22	0.685	.0856
	10		9	0.470	0.039			10		7	8.58	0.715	.0894
2	0	6	3	0.560	0.047		8	0	25	2	8.95	0.746	.0933
	2		10	0.657	0.055			2		8	9.33	0.777	.0972
	4	7	4	0.762	0.063			4	26	2	9.71	0.810	.101
	6		10	0.874	0.073			6		8	10.11	0.842	.105
	8	8	5	0.995	0.083	.0104		8	27	3	10.51	0.876	.109
	10		11	1.12	0.094	.0117		10		9	10.91	0.910	.114
3	0	9	5	1.26	0.105	.0131	9	0	28	3	11.33	0.944	.118
	2		11	1.40	0.117	.0146		2		10	11.75	0.980	.122
	4	10	6	1.55	0.130	.0162		4	29	4	12.19	1.02	.127
	6	11	0	1.71	0.143	.0178		6		10	12.62	1.05	.132
	8		6	1.88	0.157	.0196		8	30	4	13.07	1.09	.136
	10	12	1	2.06	0.171	.0214		10		11	13.53	1.13	.141
4	0		7	2.24	0.187	.0233	10	0	31	5	13.99	1.17	.146
	2	13	1	2.43	0.202	.0253		2		11	14.46	1.20	.151
	4		7	2.63	0.219	.0274		4	32	6	14.94	1.24	.156
	6	14	2	2.83	0.236	.0295		6	33	0	15.42	1.29	.161
	8		8	3.05	0.254	.0317		8		6	15.92	1.33	.166
	10	15	2	3.27	0.272	.0340		10	34	0	16.42	1.37	.171
5	0		8	3.50	0.291	.0364	11	0		7	16.93	1.41	.176
	2	16	3	3.73	0.311	.0389		2	35	1	17.44	1.45	.182
	4		9	3.98	0.332	.0414		4		7	17.97	1.50	.187
	6	17	3	4.23	0.353	.0441		6	36	2	18.50	1.54	.193
	8		10	4.49	0.374	.0468		8		8	19.04	1.59	.198
	10	18	4	4.76	0.397	.0496		10	37	2	19.59	1.63	.204
6	0		10	5.04	0.420	.0525	12	0		8	20.14	1.68	.210
	2	19	4	5.32	0.443	.0554		2	38	3	20.71	1.73	.216
	4		11	5.61	0.468	.0584		4		9	21.28	1.77	.222
	6	20	5	5.91	0.493	.0616		6	39	3	21.86	1.82	.228
	8		11	6.22	0.518	.0648		8		10	22.44	1.87	.234
	10	21	6	6.53	0.544	.0680		10	40	4	23.04	1.92	.240

Your well can't produce more than the screen allows



The Layne Screen, by utilizing every inch of screening surface, allows full production without hindrance. Being free of sand-cutting or clogging, a Layne Screen will give you longer service without interrupting production.

Protect your well investment by installing Layne Screens. They are available in any size or kind of pipe from 1" to 16" in diameter with either Milled Groove, Plain Drilled or Slotted perforations. All Layne Screens are made to order, and can be had in any gauge desired from 4/1000 of an inch upward.

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CLEARANCE BETWEEN DRILL PIPE AND CASING, IN.

Casing size			Drill pipe diameter															
			2⅜-in.		2⅞-in.		3½-in.		4½-in.		5⁹⁄₁₆-in.		6⅝-in.		7⅝-in.		8⅝-in.	
O.D., in.	Weight, lb. per ft. complete with couplings	I.D., in.	Pipe, 2.375	Coupling, 3.125	Pipe, 2.875	Coupling, 3.750	Pipe, 3.500	Coupling, 4.250	Pipe, 4.500	Coupling, 5.500	Pipe, 5.563	Coupling, 6.750	Pipe, 6.625	Coupling, 7.750	Pipe, 7.625	Coupling, 8.875	Pipe, 8.625	Coupling, 10.000
9	34.00	8.290	2.957	2.582	2.707	2.270	2.395	2.020	1.895	1.395	1.363	0.769	0.832	0.269				
	38.00	8.196	2.910	2.535	2.660	2.223	2.348	1.973	1.848	1.348	1.316	0.722	0.785	0.222				
	40.00	8.150	2.887	2.512	2.637	2.200	2.325	1.950	1.825	1.325	1.293	0.699	0.762	0.199				
	45.00	8.032	2.828	2.453	2.578	2.141	2.266	1.891	1.766	1.266	1.234	0.640	0.703	0.140				
9⅝	36.00	8.921	3.273	2.898	3.023	2.586	2.711	2.336	2.211	1.711	1.679	1.085	1.148	0.585	0.648	0.023		
	38.00	8.885	3.255	2.880	3.005	2.568	2.693	2.318	2.193	1.693	1.661	1.067	1.130	0.567	0.630	0.005		
	40.00	8.835	3.230	2.855	2.980	2.543	2.668	2.293	2.168	1.668	1.636	1.042	1.105	0.542				
	42.00	8.799	3.212	2.837	2.962	2.525	2.650	2.275	2.150	1.650	1.618	1.024	1.087	0.524				
	43.50	8.755	3.190	2.815	2.940	2.503	2.628	2.253	2.128	1.628	1.596	1.002	1.065	0.502				
10	33.00	9.384	3.504	3.129	3.254	2.817	2.942	2.567	2.442	1.942	1.910	1.316	1.379	0.816	0.879	0.254		
10¾	40.50	10.050	3.837	3.462	3.587	3.150	3.275	2.900	2.775	2.275	2.243	1.649	1.712	1.149	1.212	0.587	0.712	0.025
	45.50	9.950	3.787	3.412	3.537	3.100	3.225	2.850	2.725	2.225	2.193	1.599	1.662	1.099	1.162	0.537		
	51.00	9.850	3.737	3.362	3.487	3.050	3.175	2.800	2.675	2.175	2.143	1.549	1.612	1.049	1.112	0.487		
	55.50	9.760	3.692	3.317	3.442	3.005	3.130	2.755	2.630	2.130	2.098	1.504	1.567	1.004	1.067	0.442		
11¾	47.00	11.000	4.312	3.937	4.062	3.625	3.750	3.375	3.250	2.750	2.718	2.124	2.187	1.624	1.687	1.062	1.187	0.500
	54.00	10.880	4.252	3.877	4.002	3.565	3.690	3.315	3.190	2.690	2.658	2.064	2.127	1.564	1.627	1.002	1.127	0.440
	60.00	10.772	4.198	3.823	3.948	3.511	3.636	3.261	3.136	2.636	2.604	2.010	2.073	1.510	1.573	0.948	1.073	0.386
12	40.00	11.384	4.504	4.129	4.254	3.817	3.942	3.567	3.442	2.942	2.910	2.316	2.379	1.816	1.879	1.254	1.379	0.692
13	40.00	12.438	5.031	4.656	4.781	4.344	4.469	4.094	3.969	3.469	3.437	2.843	2.906	2.343	2.406	1.781	1.906	1.219
	45.00	12.360	4.992	4.617	4.742	4.305	4.430	4.055	3.930	3.430	3.398	2.804	2.867	2.304	2.367	1.742	1.867	1.180
	50.00	12.282	4.953	4.578	4.703	4.266	4.391	4.016	3.891	3.391	3.359	2.765	2.828	2.265	2.328	1.703	1.828	1.141
	54.00	12.220	4.922	4.547	4.672	4.235	4.360	3.985	3.860	3.360	3.328	2.734	2.797	2.234	2.297	1.672	1.797	1.110
13⅜	48.00	12.715	5.170	4.795	4.920	4.483	4.608	4.233	4.108	3.608	3.576	2.982	3.045	2.482	2.545	1.920	2.045	1.358
	54.50	12.615	5.120	4.745	4.870	4.433	4.558	4.183	4.058	3.558	3.526	2.932	2.995	2.432	2.495	1.870	1.995	1.308
	61.00	12.515	5.070	4.695	4.820	4.383	4.508	4.133	4.008	3.508	3.476	2.882	2.945	2.382	2.445	1.820	1.945	1.258
	68.00	12.415	5.020	4.645	4.770	4.333	4.458	4.083	3.958	3.458	3.426	2.832	2.895	2.332	2.395	1.770	1.895	1.208
14	50.00	13.344	5.484	5.109	5.234	4.797	4.922	4.547	4.422	3.922	3.890	3.296	3.359	2.796	2.859	2.234	2.359	1.672
16	55.00	15.375	6.500	6.125	6.250	5.813	5.938	5.563	5.438	4.938	4.906	4.312	4.375	3.812	3.875	3.250	3.375	2.688
	65.00	15.250	6.437	6.062	6.187	5.750	5.875	5.500	5.375	4.875	4.843	4.249	4.312	3.749	3.812	3.187	3.312	2.625
	70.00	15.198	6.411	6.036	6.161	5.724	5.849	5.474	5.349	4.849	4.817	4.223	4.286	3.723	3.786	3.161	3.286	2.599
	75.00	15.125	6.375	6.000	6.125	5.688	5.813	5.438	5.313	4.813	4.781	4.187	4.250	3.687	3.750	3.125	3.250	2.563
	84.00	15.010	6.317	5.942	6.067	5.630	5.755	5.380	5.255	4.755	4.723	4.129	4.192	3.629	3.692	3.067	3.192	2.505
18⅝	78.00	17.855	7.740	7.365	7.490	7.053	7.178	6.803	6.678	6.178	6.146	5.552	5.615	5.052	5.115	4.490	4.615	3.928
	87.50	17.755	7.690	7.315	7.440	7.003	7.128	6.753	6.628	6.128	6.096	5.502	5.565	5.002	5.065	4.440	4.565	3.878
	96.50	17.655	7.640	7.265	7.390	6.953	7.078	6.703	6.578	6.078	6.046	5.452	5.515	4.952	5.015	4.390	4.515	3.828
20	90.00	19.190	8.407	8.032	8.157	7.720	7.845	7.470	7.345	6.845	6.813	6.219	6.282	5.719	5.782	5.157	5.282	4.595
21½	92.50	20.710	9.167	8.792	8.917	8.480	8.605	8.230	8.105	7.605	7.573	6.979	7.042	6.479	6.542	5.917	6.042	5.355
	103.00	20.610	9.117	8.742	8.867	8.430	8.555	8.180	8.055	7.555	7.523	6.929	6.992	6.429	6.492	5.867	5.992	5.305
	114.00	20.510	9.067	8.692	8.817	8.380	8.505	8.130	8.005	7.505	7.473	6.879	6.942	6.379	6.442	5.817	5.942	5.255
24½	100.50	23.750	10.687	10.312	10.437	10.000	10.125	9.750	9.625	9.125	9.093	8.499	8.562	7.999	8.062	7.437	7.562	6.875
	113.00	23.650	10.637	10.262	10.387	9.950	10.075	9.700	9.575	9.075	9.043	8.449	8.512	7.949	8.012	7.387	7.512	6.825

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Running a string of drill pipe with Patterson-Ballagh Protectors prevents the hazard of metal-to-metal contact. You keep the tool joints away from friction. Less power is required to rotate the string. The casing you set in the well retains its original thickness. No worn spots occur to cause a water break or encourage collapsation. The same Protectors with the same drill pipe can be used again and again, in different wells — an economy not to be overlooked in this day of cutting costs.

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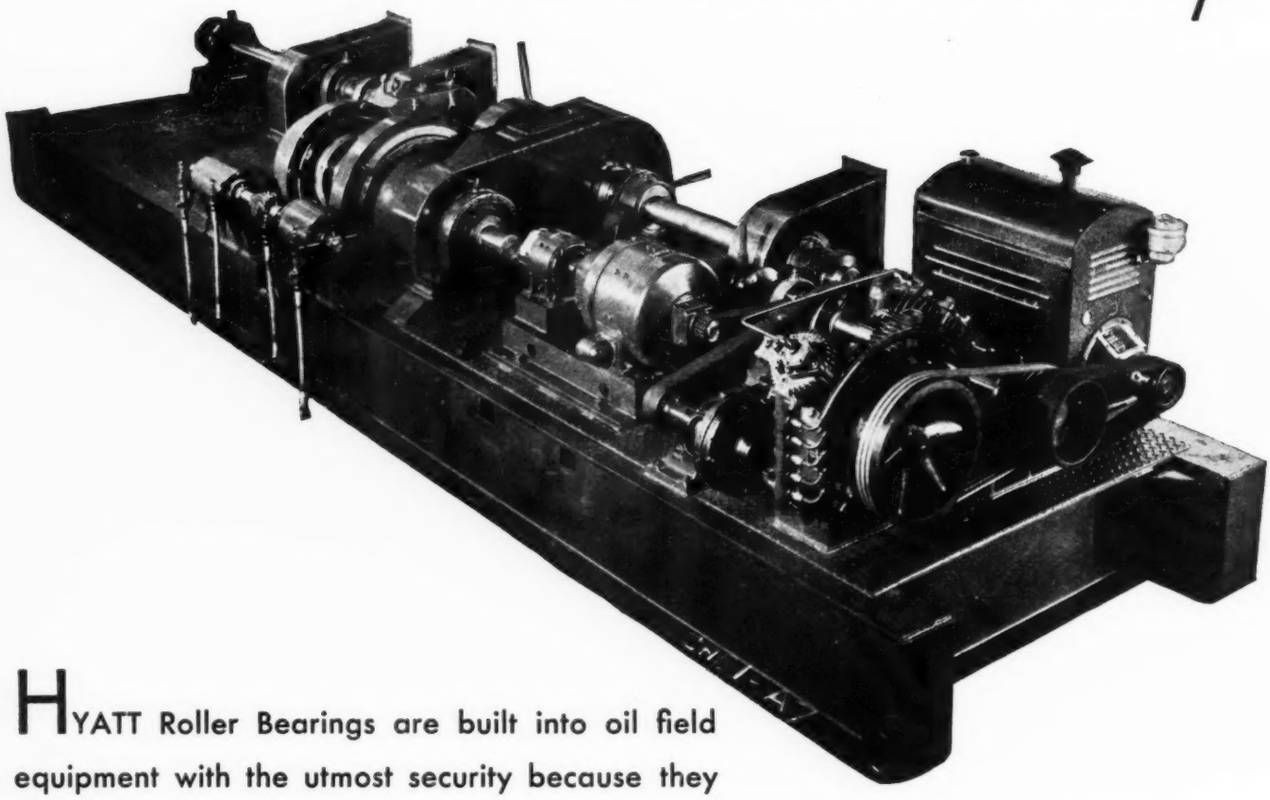
MULTIPLIERS FOR CONVERTING MEASURED VOLUME TO VOLUME AT 60 DEGREES FAHRENHEIT

Observed temp., deg. fahr.	10° A.P.I. 1.0 sp. gr.	20° A.P.I. 0.934 sp. gr.	30° A.P.I. 0.876 sp. gr.	40° A.P.I. 0.825 sp. gr.	50° A.P.I. 0.780 sp. gr.	60° A.P.I. 0.739 sp. gr.	70° A.P.I. 0.702 sp. gr.	80° A.P.I. 0.669 sp. gr.	90° A.P.I. 0.639 sp. gr.
0	1.0223	1.0239	1.0256	1.0284	1.0324	1.0370	1.0411	1.0451	1.0496
1	1.0220	1.0235	1.0251	1.0279	1.0319	1.0364	1.0404	1.0444	1.0488
2	1.0216	1.0231	1.0247	1.0275	1.0313	1.0358	1.0397	1.0436	1.0480
3	1.0212	1.0227	1.0243	1.0270	1.0308	1.0351	1.0391	1.0429	1.0471
4	1.0208	1.0223	1.0238	1.0266	1.0302	1.0345	1.0384	1.0421	1.0463
5	1.0204	1.0219	1.0234	1.0261	1.0297	1.0339	1.0377	1.0414	1.0455
6	1.0200	1.0215	1.0230	1.0256	1.0292	1.0333	1.0370	1.0407	1.0447
7	1.0196	1.0211	1.0226	1.0251	1.0286	1.0327	1.0363	1.0399	1.0439
8	1.0193	1.0207	1.0221	1.0247	1.0281	1.0321	1.0357	1.0392	1.0430
9	1.0189	1.0203	1.0217	1.0242	1.0275	1.0315	1.0350	1.0384	1.0422
10	1.0185	1.0199	1.0213	1.0237	1.0270	1.0309	1.0343	1.0377	1.0414
11	1.0181	1.0195	1.0209	1.0232	1.0265	1.0303	1.0336	1.0370	1.0406
12	1.0177	1.0191	1.0205	1.0227	1.0259	1.0297	1.0329	1.0362	1.0398
13	1.0174	1.0187	1.0200	1.0223	1.0254	1.0290	1.0323	1.0355	1.0389
14	1.0170	1.0183	1.0196	1.0218	1.0248	1.0284	1.0316	1.0347	1.0381
15	1.0166	1.0179	1.0192	1.0213	1.0243	1.0278	1.0309	1.0340	1.0373
16	1.0162	1.0175	1.0188	1.0208	1.0238	1.0272	1.0302	1.0332	1.0365
17	1.0159	1.0171	1.0183	1.0203	1.0232	1.0266	1.0295	1.0325	1.0357
18	1.0155	1.0167	1.0179	1.0199	1.0227	1.0259	1.0289	1.0317	1.0348
19	1.0152	1.0163	1.0174	1.0194	1.0221	1.0253	1.0282	1.0310	1.0340
20	1.0148	1.0159	1.0170	1.0189	1.0216	1.0247	1.0275	1.0302	1.0332
21	1.0144	1.0155	1.0166	1.0184	1.0211	1.0241	1.0268	1.0295	1.0324
22	1.0140	1.0151	1.0162	1.0180	1.0205	1.0235	1.0261	1.0287	1.0316
23	1.0137	1.0147	1.0157	1.0175	1.0200	1.0229	1.0255	1.0280	1.0307
24	1.0133	1.0143	1.0153	1.0171	1.0194	1.0223	1.0248	1.0272	1.0299
25	1.0129	1.0139	1.0149	1.0166	1.0189	1.0217	1.0241	1.0265	1.0291
26	1.0125	1.0135	1.0145	1.0161	1.0184	1.0211	1.0234	1.0257	1.0283
27	1.0122	1.0131	1.0141	1.0156	1.0178	1.0205	1.0227	1.0250	1.0275
28	1.0118	1.0127	1.0136	1.0152	1.0173	1.0198	1.0221	1.0242	1.0266
29	1.0115	1.0123	1.0132	1.0147	1.0167	1.0192	1.0214	1.0235	1.0258
30	1.0111	1.0119	1.0128	1.0142	1.0162	1.0186	1.0207	1.0227	1.0250
31	1.0107	1.0115	1.0124	1.0137	1.0157	1.0180	1.0200	1.0220	1.0242
32	1.0103	1.0111	1.0119	1.0133	1.0151	1.0174	1.0193	1.0212	1.0234
33	1.0100	1.0107	1.0115	1.0128	1.0146	1.0167	1.0186	1.0205	1.0225
34	1.0096	1.0103	1.0110	1.0124	1.0140	1.0161	1.0179	1.0197	1.0217
35	1.0092	1.0099	1.0106	1.0119	1.0135	1.0155	1.0172	1.0190	1.0209
36	1.0088	1.0095	1.0102	1.0114	1.0130	1.0149	1.0165	1.0182	1.0201
37	1.0084	1.0091	1.0098	1.0109	1.0124	1.0143	1.0158	1.0175	1.0192
38	1.0081	1.0087	1.0093	1.0105	1.0119	1.0136	1.0152	1.0167	1.0184
39	1.0077	1.0083	1.0089	1.0100	1.0113	1.0130	1.0145	1.0160	1.0175
40	1.0073	1.0079	1.0085	1.0095	1.0108	1.0124	1.0138	1.0152	1.0167
41	1.0069	1.0075	1.0081	1.0090	1.0103	1.0118	1.0131	1.0144	1.0159
42	1.0066	1.0071	1.0077	1.0085	1.0097	1.0112	1.0124	1.0137	1.0150
43	1.0062	1.0067	1.0072	1.0081	1.0091	1.0105	1.0118	1.0129	1.0142
44	1.0059	1.0063	1.0068	1.0076	1.0086	1.0099	1.0111	1.0122	1.0133
45	1.0055	1.0059	1.0064	1.0071	1.0081	1.0093	1.0104	1.0114	1.0125
46	1.0051	1.0055	1.0060	1.0066	1.0076	1.0087	1.0097	1.0106	1.0117
47	1.0048	1.0051	1.0055	1.0061	1.0070	1.0081	1.0090	1.0099	1.0109
48	1.0044	1.0047	1.0051	1.0057	1.0065	1.0074	1.0083	1.0091	1.0100
49	1.0041	1.0043	1.0046	1.0052	1.0059	1.0068	1.0076	1.0084	1.0092
50	1.0037	1.0039	1.0042	1.0047	1.0054	1.0062	1.0069	1.0076	1.0084
51	1.0033	1.0035	1.0038	1.0042	1.0049	1.0056	1.0062	1.0068	1.0076
52	1.0029	1.0031	1.0034	1.0038	1.0043	1.0050	1.0055	1.0061	1.0067
53	1.0026	1.0028	1.0029	1.0033	1.0038	1.0043	1.0049	1.0053	1.0059
54	1.0022	1.0024	1.0025	1.0029	1.0032	1.0037	1.0042	1.0046	1.0050
55	1.0018	1.0020	1.0021	1.0024	1.0027	1.0031	1.0035	1.0038	1.0042
56	1.0014	1.0016	1.0017	1.0019	1.0022	1.0025	1.0028	1.0030	1.0034
57	1.0011	1.0012	1.0013	1.0014	1.0016	1.0019	1.0021	1.0023	1.0025
58	1.0007	1.0008	1.0008	1.0010	1.0011	1.0012	1.0014	1.0015	1.0017
59	1.0004	1.0004	1.0004	1.0005	1.0005	1.0006	1.0007	1.0008	1.0008
60	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

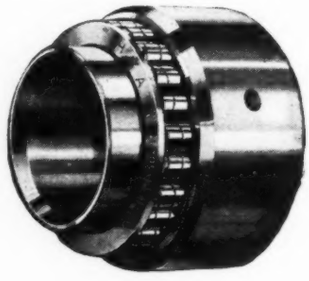
SECURITY with HYATT *Roller Bearings*



HYATT Roller Bearings are built into oil field equipment with the utmost security because they protect vital working parts against shocks, wear and misalignment. Years of successful experience have proved that these dependable bearings help extend equipment life and assure smoother, quieter, and more efficient operation with less care.

Thus is Hyatt protection—the result of correct bearing design, sound application, and precision manufacture by Hyatt engineers and craftsmen—generously contributing to greater production. Is there any further way we may serve you? Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

This **CONTINENTAL-SHELDON "CHB"** Compounding Transmission is another oil field unit that is earning a name for itself along with the many leading makes of equipment employing dependable Hyatt Roller Bearings.



CROSS-SECTION AREA OF ANNULAR SPACE BETWEEN DRILL PIPE AND CASING, SQ. IN.

Casing diameter, O.D., in.	Weight, complete with couplings, lb. per ft.	Actual I.D., in.	Internal cross-section area of casing, sq. in.	Diameter of drill pipe, in.							
				2⅜	2⅞	3½	4½	5⅝	6⅝	7⅝	8⅝
4¾	16.00	4.082	13.087	8.657	6.595						
5	13.00	4.494	15.862	11.432	9.370						
	15.00	4.408	15.261	10.831	8.769						
	18.00	4.276	14.360	9.930	7.868						
	21.00	4.154	13.553	9.123	7.061						
5½	14.00	5.012	19.729	15.299	13.237	10.108					
	17.00	4.892	18.796	14.366	12.304	9.175					
	20.00	4.778	17.930	13.500	11.438	8.309					
5¾	14.00	5.290	21.979	17.549	15.487	12.358					
	17.00	5.190	21.156	16.726	14.664	11.535					
	19.50	5.090	20.348	15.918	13.856	10.727					
	22.50	4.990	19.557	15.127	13.065	9.936					
6	20.00	5.352	22.497	18.067	16.005	12.876					
6⅝	20.00	6.049	28.738	24.308	22.246	19.117	12.834				
	22.00	5.989	28.171	23.741	21.679	18.550	12.267				
	24.00	5.921	27.535	23.105	21.043	17.914	11.631				
	26.00	5.855	26.924	22.494	20.432	17.303	11.020				
	28.00	5.791	26.339	21.909	19.847	16.718	10.435				
7	17.00	6.538	33.572	29.142	27.080	23.951	17.668				
	20.00	6.456	32.735	28.305	26.243	23.114	16.831				
	22.00	6.398	32.150	27.720	25.658	22.529	16.246				
	24.00	6.336	31.530	27.100	25.038	21.909	15.626				
	26.00	6.276	30.935	26.505	24.443	21.314	15.031				
	28.00	6.214	30.327	25.897	23.835	20.706	14.423				
	30.00	6.154	29.744	25.314	23.252	20.123	13.840				
	43.00	5.736	25.841	21.411	19.349	16.220	9.937				
7⅝	26.40	6.969	38.144	33.714	31.652	28.523	22.240				
	29.70	6.875	37.122	32.692	30.630	27.501	21.218				
	33.70	6.765	35.944	31.514	29.452	26.323	20.040				
8	26.00	7.386	42.846	38.416	36.354	33.225	26.942	18.540			
8⅛	28.00	7.485	44.002	39.572	37.510	34.381	28.098	19.696			
	32.00	7.385	42.834	38.404	36.342	33.213	26.930	18.528			
	35.50	7.285	41.682	37.252	35.190	32.061	25.778	17.376			
	39.50	7.185	40.546	36.116	34.054	30.925	24.642	16.240			
8⅝	28.00	8.017	50.479	46.049	43.987	40.858	34.575	26.173			
	32.00	7.921	49.278	44.848	42.786	39.657	33.374	24.972			
	36.00	7.825	48.091	43.661	41.599	38.470	32.187	23.785			
	38.00	7.775	47.478	43.048	40.986	37.857	31.574	23.172			
	43.00	7.651	45.976	41.546	39.484	36.355	30.072	21.670			
9	34.00	8.290	53.976	49.546	47.484	44.355	38.072	29.670	19.504		
	38.00	8.196	52.759	48.329	46.267	43.138	36.855	28.453	18.287		
	40.00	8.150	52.168	47.738	45.676	42.547	36.264	27.862	17.696		
	45.00	8.032	50.669	46.239	44.177	41.048	34.765	26.363	16.197		
9⅝	36.00	8.921	62.505	58.075	56.013	52.884	46.601	38.199	28.033		
	38.00	8.885	62.002	57.572	55.510	52.381	46.098	37.696	27.530		
	40.00	8.835	61.306	56.876	54.814	51.685	45.402	37.000	26.834		
	42.00	8.799	60.808	56.378	54.316	51.187	44.904	36.502	26.336		
	43.50	8.755	60.201	55.771	53.709	50.580	44.297	35.895	25.729		
10	33.00	9.384	69.162	64.732	62.670	59.541	53.258	44.856	34.690	23.498	
10¾	40.50	10.050	79.327	74.897	72.835	69.706	63.423	55.021	44.855	33.663	
	45.50	9.950	77.757	73.327	71.265	68.136	61.853	53.451	43.285	32.093	
	51.00	9.850	76.201	71.771	69.709	66.580	60.297	51.895	41.729	30.537	
	55.50	9.760	74.815	70.385	68.323	65.194	58.911	50.509	40.343	29.151	
11¾	47.00	11.000	95.033	90.603	88.541	85.412	79.129	70.727	60.561	49.369	36.607
	54.00	10.880	92.971	88.541	86.479	83.350	77.067	68.665	58.499	47.307	34.545
	60.00	10.772	91.135	86.705	84.643	81.514	75.231	66.829	56.663	45.471	32.709
12	40.00	11.384	101.784	97.354	95.292	92.163	85.880	77.478	67.312	56.120	43.358
13	40.00	12.438	121.504	117.074	115.012	111.883	105.600	97.198	87.032	75.840	63.078
	45.00	12.360	119.985	115.555	113.493	110.364	104.081	95.679	85.513	74.321	61.559
	50.00	12.282	118.476	114.046	111.984	108.855	102.572	94.170	84.004	72.812	60.050
	54.00	12.220	117.283	112.853	110.791	107.662	101.379	92.977	82.811	71.619	58.857
13⅜	48.00	12.715	126.977	122.547	120.485	117.356	111.073	102.671	92.505	81.313	68.551
	54.50	12.615	124.987	120.557	118.495	115.366	109.083	100.681	90.515	79.323	66.561
	61.00	12.515	123.013	118.583	116.521	113.392	107.109	98.707	88.541	77.349	64.587
	68.00	12.415	121.055	116.625	114.563	111.434	105.151	96.749	86.583	75.391	62.629
14	50.00	13.344	139.850	135.420	133.358	130.229	123.946	115.544	105.378	94.186	81.424
16	55.00	15.375	185.661	181.231	179.169	176.040	169.757	161.355	151.189	139.997	127.235
	65.00	15.250	182.655	178.225	176.163	173.034	166.751	158.349	148.183	136.991	124.229
	70.00	15.198	181.411	176.981	174.919	171.790	165.507	157.105	146.939	135.747	122.985
	75.00	15.125	179.673	175.243	173.181	170.052	163.769	155.367	145.201	134.009	121.247
	84.00	15.010	176.951	172.521	170.459	167.330	161.047	152.645	142.479	131.287	118.525
18⅝	78.00	17.855	250.386	245.956	243.894	240.765	234.482	226.080	215.914	204.722	191.960
	87.50	17.755	247.590	243.160	241.098	237.969	231.686	223.284	213.119	201.926	189.164
	96.50	17.655	244.808	240.378	238.316	235.187	228.904	220.502	210.336	199.144	186.382
20	90.00	19.190	289.228	284.798	282.736	279.607	273.324	264.922	254.756	243.564	230.802
21½	92.50	20.710	336.861	332.431	330.369	327.240	320.957	312.555	302.389	291.197	278.435
	103.00	20.610	333.616	329.186	327.124	323.995	317.712	309.310	299.144	287.952	275.190
	114.00	20.510	330.386	325.956	323.894	320.765	314.482	306.080	295.914	284.722	271.960
24½	100.50	23.750	443.015	438.585	436.523	433.394	427.111	418.709	408.543	397.351	384.589
	113.00	23.650	439.292	434.862	432.800	429.671	423.388	414.986	404.820	393.628	380.866

SOUTH CHESTER CASING IS SPECIALIZED CASING . .

You can place the utmost confidence in Chester Casing and Couplings. They are built to withstand the tough conditions—in every application for which they are recommended. Where service conditions are the most difficult, experienced drillers specify "Chester" for dependable operation.

Threads will not strip under the heavy load of a heavy string of casing and galling and burning of Chester High Tensile threads is almost unknown.

For all your pipe requirements—you can't go wrong when you say "Chester!"

SOUTH CHESTER TUBE CO.
CHESTER, PA.

District Sales Managers

F. H. Gibson, 1331 Gulf Bldg., Pittsburgh, Pa.

J. P. Cooney, 715-716 A. G. Bartlett Bldg., Los Angeles, Calif.

J. P. Steele, Petroleum Bldg., Fort Worth, Texas.

J. D. Swartz, Beacon Bldg., Tulsa, Oklahoma.

E. L. Moseley, 2218 Mills Street, Houston, Texas.

District Offices

South Chester Tube Co., 1708 Hudson Terminal Bldg., 30 Church St., New York, N. Y.

District Warehouses

Houston, Texas; Thenard, Calif.; San Francisco, Calif.

Distributors

Western Supply Co., Tulsa, Okla., and Branches.

International Supply Co., Tulsa, Okla., and Branches.

Dunigan Tool & Supply Co., Breckenridge, Texas, and Branches.

Bridgeport Machine Co., Wichita, Kans., and Branches.

Louisiana Supply Co., Sulphur and Brimstone, La.

Industrial Supply Company, Inc., Wichita Falls, Texas, and Branches.

Decker Tool & Supply Co., Electra, Texas, and Branches.

J. E. Matthews, Ranger, Texas.

Stephen H. McCabe, 508 4th St., San Francisco, Calif.

Viking Automatic Sprinkler Co., 2715 East 12th St., Los Angeles, Calif.

Herley Supply Co., 3006 Cherry Ave., Long Beach, Calif.

Tubular Sales Company, 811 W. Seventh St. Bldg., Los Angeles, Calif.

Barde Steel Co., Seattle, Wash., and Portland, Ore.

Star Drilling Machine Co., 550 Clinton St., Portland, Ore., and Akron, Ohio.

The Atha Supply Co., Zanesville, O., and Mt. Pleasant, Mich.

United Pipe & Supply Corporation, Charleston, W. Va., and Branches.

Prichard Supply Co., Manningtton, W. Va., and Branches.

CHESTER

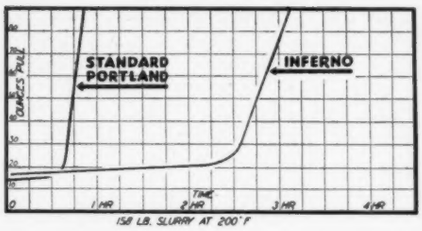
STEEL CASING AND LINE PIPE

TOTAL[1] UPWARD PRESSURE AT WELL HEAD BETWEEN DRILL PIPE AND CASING, LB.

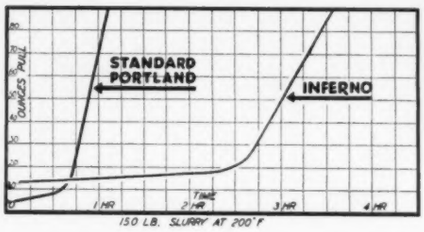
Casing diam., O.D., in.	Drill pipe diam., O.D., in.	Well head pressure, lb. per sq. in. gauge																	
		1000	2000	3000	3500	4000	4500	5000	5500	6000	6250	6500	6750	7000	7200	7400	7600	7800	8000
4¾	2⅜	8,660	17,310	25,970	30,300	34,630	38,960	43,290	47,610	51,940	54,110	56,270	58,430	60,600	62,330	64,060	65,790	67,520	69,260
	2⅞	6,600	13,190	19,780	23,080	26,380	29,680	32,980	36,270	39,570	41,220	42,870	44,520	46,170	47,480	48,800	50,120	51,440	52,760
5	2⅜	11,430	22,860	34,300	40,010	45,730	51,440	57,160	62,880	68,590	71,450	74,310	77,170	80,020	82,310	84,600	86,880	89,170	91,460
	2⅞	9,370	18,740	28,110	32,800	37,480	42,170	46,850	51,540	56,220	58,560	60,910	63,250	65,590	67,460	69,340	71,210	73,090	74,960
5½	2⅜	15,300	30,600	45,900	53,550	61,200	68,850	76,500	84,140	91,790	95,620	99,440	103,270	107,090	110,150	113,210	116,270	119,330	122,390
	2⅞	13,240	26,470	39,710	46,330	52,950	59,570	66,190	72,800	79,420	82,730	86,040	89,350	92,660	95,310	97,950	100,600	103,250	105,900
	3½	10,110	20,220	30,320	35,380	40,430	45,490	50,540	55,590	60,650	63,180	65,700	68,230	70,760	72,780	74,800	76,820	78,840	80,860
5¾	2⅜	17,550	35,100	52,650	61,420	70,200	78,970	87,750	96,520	105,290	109,680	114,070	118,460	122,840	126,350	129,860	133,370	136,880	140,390
	2⅞	15,490	30,970	46,460	54,200	61,950	69,690	77,440	85,180	92,920	96,790	100,670	104,540	108,410	111,510	114,600	117,700	120,800	123,900
	3½	12,360	24,720	37,070	43,250	49,430	55,610	61,790	67,970	74,150	77,240	80,330	83,420	86,510	88,980	91,450	93,920	96,390	98,860
6	2⅜	18,070	36,130	54,200	63,230	72,270	81,300	90,340	99,370	108,400	112,920	117,440	121,950	126,470	130,080	133,700	137,310	140,920	144,540
	2⅞	16,010	32,010	48,020	56,020	64,020	72,020	80,030	88,030	96,030	100,030	104,030	108,030	112,040	115,240	118,440	121,640	124,840	128,040
	3½	12,880	25,750	38,630	45,070	51,500	57,940	64,380	70,820	77,260	80,480	83,690	86,910	90,130	92,710	95,280	97,860	100,430	103,010
6⅝	2⅜	24,310	48,620	72,920	85,080	97,230	109,390	121,540	133,690	145,850	151,930	158,000	164,080	170,160	175,020	179,880	184,740	189,600	194,460
	2⅞	22,250	44,490	66,740	77,860	88,980	100,110	111,230	122,350	133,480	139,040	144,600	150,160	155,720	160,170	164,620	169,070	173,520	177,970
	3½	19,120	38,230	57,350	66,910	76,470	86,030	95,590	105,140	114,700	119,480	124,260	129,040	133,820	137,640	141,470	145,290	149,110	152,940
	4½	12,830	25,670	38,500	44,920	51,340	57,750	64,170	70,590	77,000	80,210	83,420	86,630	89,840	92,400	94,970	97,540	100,110	102,670
7	2⅜	29,140	58,280	87,430	102,000	116,570	131,140	145,710	160,280	174,850	182,140	189,420	196,710	203,990	209,820	215,650	221,480	227,310	233,140
	2⅞	27,080	54,160	81,240	94,780	108,320	121,860	135,400	148,940	162,480	169,250	176,020	182,790	189,560	194,980	200,390	205,810	211,220	216,640
	3½	23,950	47,900	71,850	83,830	95,800	107,780	119,760	131,730	143,710	149,690	155,680	161,670	167,660	172,450	177,240	182,030	186,820	191,610
	4½	17,670	35,340	53,000	61,840	70,670	79,510	88,340	97,170	106,010	110,430	114,840	119,260	123,680	127,210	130,740	134,280	137,810	141,340
7⅝	2⅜	33,710	67,430	101,140	118,000	134,860	151,710	168,570	185,430	202,280	210,710	219,140	227,570	236,000	242,740	249,480	256,230	262,970	269,710
	2⅞	31,650	63,300	94,960	110,780	126,610	142,430	158,260	174,090	189,910	197,830	205,740	213,650	221,560	227,890	234,220	240,560	246,890	253,220
	3½	28,520	57,050	85,570	99,830	114,090	128,350	142,620	156,880	171,140	178,270	185,400	192,530	199,660	205,370	211,070	216,770	222,480	228,180
	4½	22,240	44,480	66,720	77,840	88,960	100,080	111,200	122,320	133,440	139,000	144,560	150,120	155,680	160,130	164,580	169,020	173,470	177,920
8	2⅜	38,420	76,830	115,250	134,460	153,660	172,870	192,080	211,290	230,500	240,100	249,700	259,310	268,910	276,600	284,280	291,960	299,640	307,330
	2⅞	36,350	72,710	109,060	127,240	145,420	163,590	181,770	199,950	218,120	227,210	236,300	245,390	254,480	261,750	269,020	276,290	283,560	290,830
	3½	33,230	66,450	99,680	116,290	132,900	149,510	166,130	182,740	199,350	207,660	215,960	224,270	232,580	239,220	245,870	252,510	259,160	265,800
	4½	26,940	53,880	80,830	94,300	107,770	121,240	134,710	148,180	161,650	168,390	175,120	181,860	188,590	193,980	199,370	204,760	210,150	215,540
	5⁹⁄₁₆	18,540	37,080	55,620	64,890	74,160	83,430	92,700	101,970	111,240	115,880	120,510	125,150	129,780	133,490	137,200	140,900	144,610	148,320
8⅛	2⅜	39,570	79,140	118,720	138,500	158,290	178,070	197,860	217,650	237,430	247,330	257,220	267,110	277,000	284,920	292,830	300,750	308,660	316,580
	2⅞	37,510	75,020	112,530	131,290	150,040	168,800	187,550	206,310	225,060	234,440	243,820	253,190	262,570	270,070	277,570	285,080	292,580	300,080
	3½	34,380	68,760	103,140	120,330	137,520	154,710	171,910	189,100	206,290	214,880	223,480	232,070	240,670	247,540	254,420	261,300	268,170	275,050
	4½	28,100	56,200	84,290	98,340	112,390	126,440	140,490	154,540	168,590	175,610	182,640	189,660	196,690	202,310	207,930	213,540	219,160	224,780
	5⁹⁄₁₆	19,700	39,390	59,090	68,940	78,780	88,630	98,480	108,330	118,180	123,100	128,020	132,950	137,870	141,810	145,750	149,690	153,630	157,570

The fact that total well head pressures for unit pressures as high as 8000 lb. per sq. in. are included in the table should not be interpreted as indicating that the casing will have sufficient bursting strength to withstand such pressure. For bursting strength of casing see Table P432.2, p. 257, August, 1937, issue.

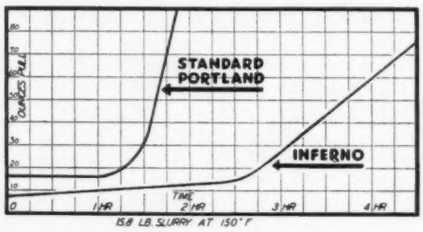
[1]Total for lightest weight casing, hence a maximum for each size casing.



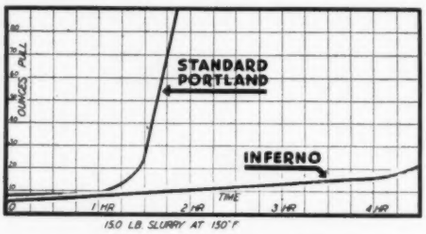
158 LB. SLURRY AT 200° F



150 LB. SLURRY AT 200° F

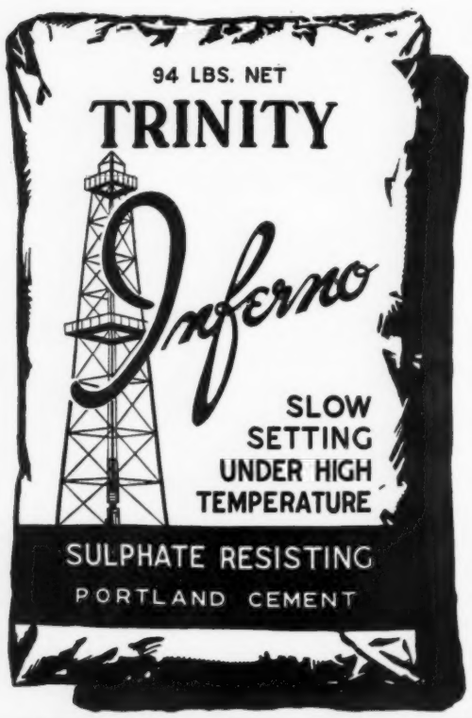


158 LB. SLURRY AT 150° F



150 LB. SLURRY AT 150° F

Charts show Comparative Fluidity of "INFERNO" Cement Slurrys at High Temperatures.



..an oil well cement for use at any depth where sulphate waters and high temperatures are encountered

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Cementing well in Rodessa field with "INFERNO" (Photo by LeDoux).